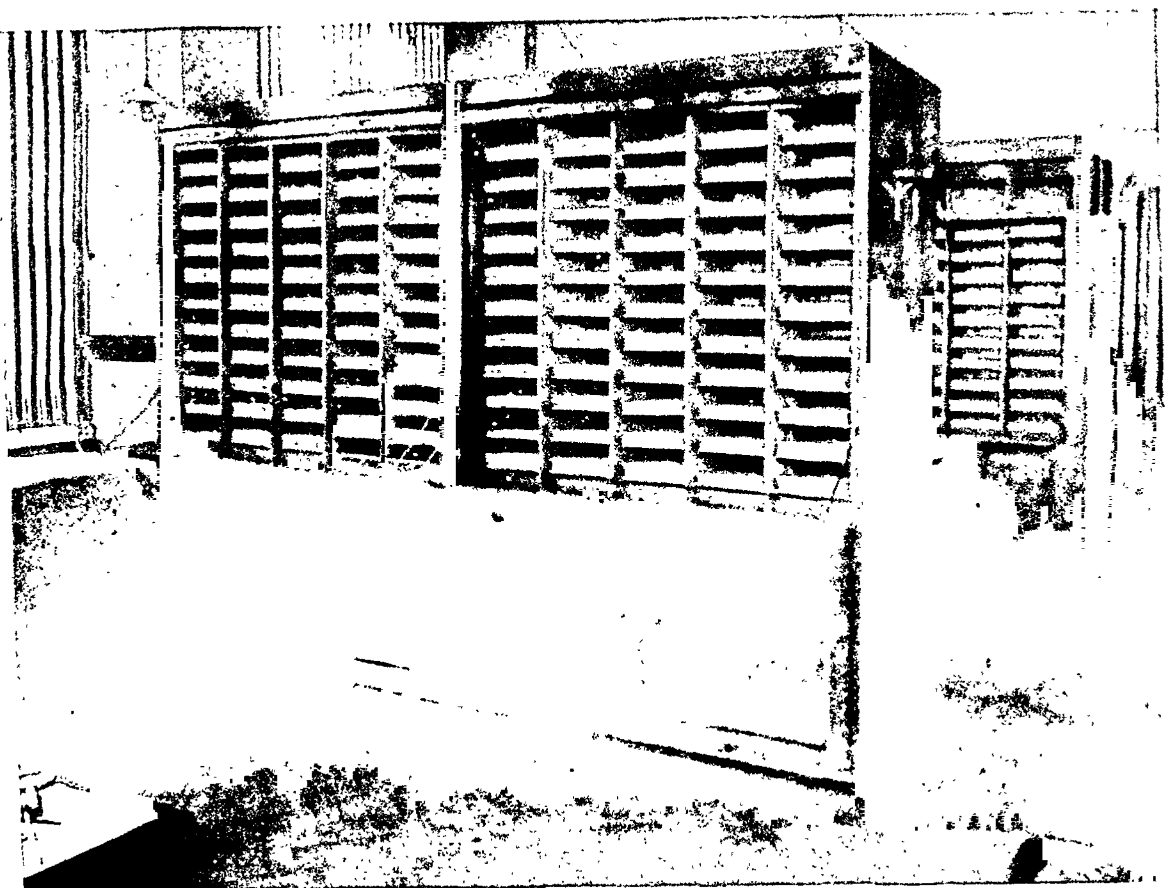


PHOTOGRAPH OF FILING CABINETS.

CLASSIFICATION AND USES

OF

FINGER PRINTS

(*FOURTH EDITION*)
TWENTY-NINTH THOUSAND

BY

SIR E. R. HENRY, G.C.V.O., K.C.B., C.S.I.

(THE COMMISSIONER OF POLICE OF THE METROPOLIS)

LONDON

LONDON
PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased, either directly or through any Bookseller, from
WYMAN AND SONS, LIMITED, FETTER LANE, E.C., and
54, ST. MARY STREET, CARDIFF, or
H.M. STATIONERY OFFICE (SCOTTISH BRANCH),
23, FORTH STREET, EDINBURGH, or
E. PONSONBY, LIMITED, 116, GRAFTON STREET, DUBLIN,
or from the Agencies in the British Colonies and Dependencies,
the United States of America, the Continent of Europe and Abroad of
T. FISHER UNWIN, LONDON, W.C.

PRINTED BY
DARLING AND SON, LTD., BACON STREET, E.
1913

Price Two Shillings

1st Issue (1900)	...	...	...	15,000
2nd Issue (1901)	...	...	...	2,000
3rd Issue (1905)	...	...	...	3,000
4th Issue (1913)	...	...	...	9,000

PREFACE

THE first edition of this work was published by request of the Government of India, subsequent editions at the instance of the Secretary of State for the Home Department

Owing to the extension of the Finger Print system of identification, the present edition has been prepared to meet the call for such a book of reference

It is divided into two Parts, over two hundred diagrams being provided to illustrate the letter press Inset headings to paragraphs and the Index will, it is hoped, facilitate search for information

Part I contains the defin[illegible] which any finger impre[illegible] described and explained [illegible] under examination [illegible] that should be comp[illegible] identity or di[illegible]

Part II. contains an account of the system of classification, the full scheme of which is set out in the Synopsis.

Endeavour has been made to compress the letterpress into the smallest space compatible with clearness and completeness of description.

1st March, 1913.

PART I

FINGER PRINTS

PART I

Earlier inquiries into the subject.—The employment during past times of finger prints among various nations is discussed in the writings of the late Sir Francis Galton, who found the significance attached to their use to have been partly superstitious and partly ceremonial. As bearing upon this point he refers to the modern witness who, when sworn on the Bible, is made to hold it and kiss it, and to the executant of a document who touches a wafer or seal and declares "this to be my act and deed." In 1823, Purkenje, a Professor of Physiology and Pathology, read before the University of Breslau a Latin Thesis on finger impressions, in which he gives nine standard types, and suggests a system of classification, but his labours failed to attract the attention they merited. Bewick, the reviver of wood-printing in England, appears to have been struck with the delicacy of the lineations, for he made engravings on wood of a couple of his fingers, which he used as designs for his illustrated works. Sir Francis Galton also tells us that when the immigration of the Chinese was causing so much excitement in America the suggestion was made, but not acted on, that a system of finger-printing might be used for their registration. But no departure at any time previously made is

comparable in importance with the systematised labours in this direction of Sir William Herschel, of the Indian Civil Service. Finding false personation prevalent in all the Courts, he determined to introduce the use of finger impressions in the district of Hooghly, in Bengal, of which he was then in executive charge, as a means of fixing identity, and accordingly insisted upon executants of documents admitted to registration affixing their finger impression in the Register of Admissions. He submitted a report to the Government advocating the adoption of this system throughout the Province; but the subject had not then been sufficiently popularised, and his recommendation met the fate of many other good suggestions and was not acted upon, and after his departure the check he had introduced was abandoned.

His labours have not, however, been unfruitful, for he collected many of the materials without which Sir Francis Galton, who commenced his investigation of the subject about twenty years ago, would not have been able to fix so securely the foundations of this new branch of inquiry. In addition to providing types and a nomenclature, suggesting a system of classification and examining the character and purpose of the ridges in their physiological aspect, Sir Francis Galton has discussed the all-important question of Persistence, and has proved that the details of the ridges constituting the patterns of finger impressions persist throughout the whole period representing the life of man, those found on the fingers of the new-born infant being traceable on the fingers of the same person in old age and apparently effaceable only when

after death, decomposition sets in In dealing with the subject anthropologically, he has brought together some evidence to indicate the transmissibility of patterns by descent, but finds that no sensible amount of correlation exists between the patterns of impressions and the bodily faculties or characteristics or that these finger markings are distinctive of race or temperament In the system here described, many of his terms have been adopted, definitions accepted, and suggestions followed whenever practicable As will be explained, it has been found necessary to provide the additional nomenclature required by the increase in the number of types and patterns, and with a view to fixing these patterns, definitions have been so framed as to eliminate to a great extent transitional cases The difficulty experienced of providing a system of classification capable of dealing with large collections has been overcome mainly by the device of placing it upon a number basis thereby doing away with the need of employing the suffixes on which Sir Francis Galton's method relied But these are details which can be more conveniently treated later on, and are only noticed now when referring to the great value and to the extent of Sir Francis Galton's inquiries into the subject [1]

Finger prints utilized in many branches of public business —In India the employment of the new system has not been restricted to the Police

[1] 'Finger Prints and the Detection of Crime in India a paper read before the British Association Meeting, Dover, 1899, by Mr E R Henry, C S I

Department, but has been introduced into all branches of public business, being particularly well suited to the requirements of a country where the mass of the people are uneducated, and where false personation is an evil which even the penalties provided by the penal laws are powerless to control. It is believed that, on the death of pensioners, friends or relations have personated them and have continued to draw allowances which should have lapsed with the death of the persons to whom they were originally granted. All military and all civil pensioners are now required to give their finger impressions, and this precaution is effective against fraud. The Courts have to deal with numerous contested cases in which transfers of proprietary or other rights, purporting to have been duly admitted in the presence of witnesses before a registrar of deeds, are repudiated, and evidence is adduced on either side, often of the most conflicting and indecisive nature, both parties not hesitating to rely upon suborned testimony. In the registration offices of the Province of Bengal, and now in all the Provinces of India, persons who, admitting execution, present documents for registration, are required to authenticate their signature or mark by affixing the impression of their left thumb both on the document and in a register kept for the purpose. Should an executant repudiate as not genuine a deed which purports to be a transfer by him of certain rights, the judicial officer can require the person repudiating to give his thumb impression in open Court, and this is compared with the impression on the document and in the register, and can be proved to be either

the same or a different impression, and this settles the point at issue. In this way, during recent years, numerous cases of false personation have been detected and prosecuted to conviction, and the deterrent effect has been so marked as to justify the belief that the volume of work which the Courts have to cope with will be sensibly reduced in amount.

In the Opium Department large advances are made on account to the cultivators through middlemen, the poppy crop being hypothecated as security. If the middleman or cultivator proves dishonest, the issue is raised whether particular sums reached the persons they were intended for. Formerly the cultivator could disown his mark or signature, or the middleman could put forward as the cultivator's mark or signature one that had been fraudulently made; but as the finger impression of the payee is now required to authenticate acknowledgment of receipt, a check has been introduced, the efficacy of which both cultivators and middlemen fully appreciate The employer who makes advances to labourers, or pays them salaries, or enters into contracts with them, now protects himself by taking their finger prints on the receipt or agreement. All emigrants signing contracts under the Emigration Act are required to give the impression of their left thumb on the contract and on the registers. With large establishments, such as are employed by the Survey of India, this system is used to prevent the re-employment of undesirable persons whose services have been dispensed with. The thumb impressions

of the employees are taken and registered, and if a particular man is dismissed for misbehaviour, a photo-zincograph of his impression is sent to all the working parties, which ensures that he cannot again get taken on, even by assuming a false name.

Since April 1899 the system has been adopted by the Director-General of the Post Offices of India, and has been made applicable to all present and future non-gazetted officers, who number many thousands. In the Medical Department of the Government of India, the local medical officer and the Medical Board, when giving certificates, invariably take the thumb impression of the person examined. There is believed to be much false personation at public examinations in India, the candidate who appears in the Examination Hall not being the person who secured the certificate entitling him to compete. In examinations for employment in one branch of Government service this check has been introduced, and is working excellently, and it will no doubt be extended. In connection with the administration of the rules for preventing the spread of plague, and for regulating the pilgrimage of Mussulmans to Mecca, certificates are authenticated by bearing the thumb impression of the persons to whom they are granted.

It would be tedious to enumerate at greater length the many uses to which the system is being put, though as yet its value to insurance offices has not been realised, the difficulty, probably, being that, owing to the circumstances of the country, bodies are buried or burnt almost as soon

as death occurs There is no doubt that the impression of the finger of a dead person taken before decomposition sets in would fix his identity in a most convincing way if the deceased had at any previous time been required to give the impression of the same finger Its value as a means of authenticating testamentary dispositions cannot be over estimated

It must be recognised that the introduction of finger impressions in proof or disproof of identity where the person in question is known and accessible, and has given his mark on a previous occasion, is an extraordinarily efficient method of preventing perjury and personation No objection can be raised on the ground of religion or caste, or rank in society, or sex, so there is no prejudice to be overcome in obtaining it The Government has been so fully convinced of the effectiveness of this new system, and of the certainty of the results it yields, that the Indian Legislature has passed a special Act[1] amending the Law of Evidence to the extent of declaring relevant the testimony of those who by study have become proficient in finger print decipherment, such testimony not having been admissible under the unamended law[2]

Since the publication of the first edition of this work in June 1900, the system therein described has been introduced extensively all over the world

[1] Act V of 1899 (India Council)

[2] "Finger Prints and the Detection of Crime in India," a paper read before the British Association Meeting, Dover, 1899, by Mr E R Henry, C S I

It has been adopted throughout Australasia; in Ceylon; in South Africa, where it is utilised not only for police purposes but also for the registration of South African natives by the Labour Pass Office and of the Chinese by the Foreign Labour Department of the Transvaal Administration. This latter office had a collection in 1905 of about 50,000 sets of prints and practically the only method employed for identifying these Chinese was that of utilising their finger prints, and it proved most effective in detecting deserters.

It has been introduced into Ireland and Canada and is being used by the following police departments in the United States, New York, Chicago, Cleveland, Cincinnati, Washington, Chattanooga, Memphis, Auburn, Binghampton, Indianapolis, Grand Rapids, Jacksonville, Louisville, Lowell, Kansas City, St. Louis, Baltimore, San Francisco—Central bureaus of identification having been established at St. Louis for the State of Missouri, at Baltimore for the State of Maryland, and at San Francisco for the State of California, and a Bill has passed the Massachusetts State Legislature providing for the introduction of the system and the establishment of a central bureau at Boston. Many of the prisons in the States of New York, Pennsylvania, Kansas, Georgia, have also adopted it.

This work has been translated into German by Herren Kamillo Windt, and Siegmund Kodkrie, of Vienna, and into Hungarian by Dr. Gabor Bela, and Dr. H. Aranyi Takrony, with a view to the system

being introduced into the countries where these languages prevail.

There seems to exist good reason for believing, in view of its effectiveness, simplicity of working, certainty as to results and inexpensiveness, that it must ultimately be adopted by all States.

It was introduced into England and Wales in July 1901, where the results obtained have been most satisfactory, the number of identifications made during the year ending 31st Dec. 1911, being more than twenty times greater than the largest number of recognitions effected by the anthropometric method. This method it superseded under the orders of the Secretary of State for the Home Department upon the recommendation of a committee presided over by Lord Belper, appointed to inquire into the best method of effecting criminal identification.

The record of finger prints is maintained for England and Wales at New Scotland Yard, by direction of the Home Secretary.

For the first few months after the introduction of the system, the registration by finger prints of all persons convicted at courts of Quarter Sessions and Assizes, and sentenced to one month's imprisonment or more was prescribed; but as officers became familiar with the work, the scope of this registration was extended, and the existing orders provide for the inclusion of all persons convicted at courts of Quarter Sessions and Assizes, sentenced to a term of not less than one month's imprisonment, or at any Petty Sessional, Police, or Stipendiary Magistrate's court to more than one month's imprisonment without

option of fine for the commission of any of the following offences :—

Arson.
Assaults with intent to rob.
Attempted burglary.
Attempted carnal knowledge.
Attempted larceny.
Attempted rape.
Attempts to break into churches, houses, shops, warehouses, &c.
Attempts to obtain goods and money by false pretences.
Bankruptcy offences.
Being found on enclosed premises.
Breaking into churches, houses, shops, warehouses, &c.
Brothel keeping.
Burglary.
Carnal knowledge.
Cattle stealing.
Coining.
Conspiracies of all descriptions.
Embezzlement.
Entering with intent to commit a felony.
Extortion by threats.
Felonious wounding.
Forgery.
Fraud.
Frequenting.
Horse stealing.
Housebreaking.

Importuning male persons to commit unnatural offences (Vagrancy Act, 1898, Sec. 1, par. *b*).
Incest.
Indecent assault on female.
Larceny.
Obtaining goods and money by false pretences.
Possessing housebreaking tools.
Procuration of women and girls.
Prostitution, Living on proceeds of (Vagrancy Act, 1898, Sec. 1, par. *a*).
Rape.
Receiving.
Robbery.
Sacrilege.
Sheepstealing.
Shopbreaking.
Suspected person.
Unlawful possession.
Uttering counterfeit coin.
Warehousebreaking.

All persons coming within the above category, also incorrigible rogues and all expelled aliens, are finger printed by the warder staff at the prisons where they are undergoing sentence and the slips containing their finger prints are then forwarded for registration and record by the Governors of Prisons to the Habitual Criminals Registry, New Scotland Yard.

The prints of remanded prisoners are, when taken, at once despatched to the Habitual Criminals Registry, New Scotland Yard, for search, and if identified the prisoner's criminal record, including his photograph

if it exists, is forwarded to the police force making the application. If no previous conviction is traced the slip is retained until the completion of the case before the Court, when, according to the facts established, it is either placed in the Record or destroyed.

It often happens, when the enquiry above indicated has not been made by the local police during the investigation of the case, that the finger prints taken *after* a prisoner's conviction and sent up to the Registry lead to the discovery that he has been previously convicted under a different name.

Hitherto the requirements of criminal administration have been sufficiently met by including persons convicted of the offences above named, sentenced to imprisonment for a month or longer; but it is obvious that if the necessity should arise to include other cases it will be quite a simple matter to still further reduce the size of the meshes of the net so as to keep within its folds all or any classes of criminals sentenced to any term of imprisonment for any offence against the law, by merely adding to the instructions above given as to those whose finger prints may be required.

The late Sir Alfred Wills, when editing, in 1911, the sixth edition of his father's work, "Wills on Circumstantial Evidence,"* added a chapter on the

* Published by Butterworth & Co., 11 and 12, Bell Yard, Temple Bar, London; 76, Elizabeth Street, Sydney, N.S.W.; and 8/2, Hastings Street, Calcutta.

Finger Print System of Identification, which includes the following —

"Identification by FINGER PRINTS has become a most "important branch of criminal investigation, and has proved "to be of signal service both in the detection of crime and "the identification of the offender The system is new, and "had only just been introduced into this country when the "last edition of this work was published, and it is only quite "lately that the conclusive nature of the evidence that it "affords has been appreciated in the Courts It may be said "now to have established its claim to admission and to "trustworthiness The processes and especially the admir "able system of classification, make it perfectly simple to "those who understand its technology Despite an appear "ance of complication, the system appears to be easily "mastered by any person of intelligence in the course of a "few months or even weeks

"It is undoubtedly of very great assistance in tracking "both criminals and crime and it would be a great hindrance "to the proper and legitimate work of the police did it fail "to command public appreciation It is felt at headquarters "that a single slip might do infinite harm, and hence a most "rigorous system of checks and counter checks has been "established, to which every finger print identification is "subjected A remarkable case tried at Birmingham in 1908 "shows that it is well to bear in mind that any particular "case may meet with considerable reluctance on the part of "judge or jury, or both, to accept evidence of a scientific "character before it has thoroughly established its own claim to recognition—a reluctance often wise as well as natural "A burglary had been committed and the offender had left "the imprint of one or more of his fingers on a champagne "bottle Twelve identical ridge characteristics were pointed "out in the two sets of impressions but the learned judge "was so far from being satisfied that he twice invited the "jury to say that they were not satisfied The jury, how "ever, did not accept the invitation and convicted the "prisoner Probably if the learned judge had had to try "the case in the year 1911 instead of 1908, the added "experience of the reliability of evidence of this class would "have led him to the same conclusion as that of the jury"

Ridges—Creases; their origin; purpose they serve.—The inner part of the hand and the sole of the foot are traversed in all directions by lines of varying lengths, some representing depressions, others elevations of the skin surface, many of them being grouped into patterns which, though seemingly complex, can be outlined with exactness. The most conspicuous are the creases, caused by the folding of the skin. These are found well developed in the newly-born child, and can be rendered more apparent by partially closing the hand. So far as is known at present they fulfil no particular office, being nothing more than the lines of flexure of the skin, and are of interest only to students of palmistry. The less conspicuous but much more numerous lines are the papillary ridges which appear over the whole surface, giving it an appearance that may be likened to that of a newly ploughed field with its ridges and furrows, or to sand which the water in receding from has left ribbed. There is no connection between the two classes of marks, the directions of the creases not determining the course of the ridges, and their embryological development being distinct. The ridges are studded with microscopic pores, the mouths of the ducts of the glands which secrete perspiration located below the epidermis. Physiologists are not agreed as to the uses of these ridges, or as to how they have been formed. It has been conjectured that their office is to raise the mouths of the ducts so as to facilitate the discharge of the sweat and also possibly to assist in some undefined way the sense of touch. In very young children the

delicacy of the ridges corresponds with the development of the child. They grow with the growth of the body, and are most marked in hands that do [illegible] work, though liable to lose their sharpness of definition and even to become partially obliterated on those parts of the hands where from continued pressure callosities form. This may be noticed in labourers [illegible] artisans whose hands have become hardened by the use of the tools or other implements of their trade. Injuries do not, necessarily, obliterate the ridges. An ulcerated sore eating so deeply into the [illegible] to destroy the sweat glands would certainly [illegible] the ridges, and from the surface of a [illegible] the ridges disappear. A cut leaves across the [illegible] a permanent thin mark which, when the [illegible] is taken on paper, shows as a white space [illegible] similar to a crease.

In addition to the creases which are [illegible] such as those marking the division [illegible] phalanges of the fingers and those [illegible] caused by the [illegible] of the [illegible] permanent may appear on the bulbs of [illegible] which [illegible] impression taken after a [illegible] needful [illegible] these creases [illegible] examination [illegible] similarity. [illegible] obviously [illegible] but two [illegible] —the [illegible] [illegible]

the edge of a steel pen, while the first is creaseless. An unskilful person missing the crease in one impression might be misled and fail to realise that the two impressions before him are identical. It cannot be too often reiterated that in comparing impressions the examiner must rely upon similarity or dissimilarity in the type and in the details of the ridges of the patterns : if his conclusions deduced therefrom are further corroborated by coinciding creases, so much the easier his task. Creases will be found in Illustrations 28, 40, 71, 72, and others. They must not be confused with cicatrised cuts (Figs. 11 and 13, and Illustrations 24 and 77) ; in the latter there is, it will be noticed, some displacement and puckering of the divided ridges.

Persistence throughout period of human life of pattern and ridge characteristics.— Impressions being required for permanent record, their utility must, in great measure, be contingent upon the persistence through long periods of time of the general form of the pattern and of the details of the ridges constituting it.

The late Sir Francis Galton has investigated this point, and in the following words records the results of his examination of many sets of prints taken at different times, and covering the interval from childhood to boyhood, from boyhood to early manhood, from early manhood to middle age, and from middle to extreme old age : "As there is no sign, except in one case, of change during any of these four intervals which together almost wholly cover the ordinary life

of man, we are justified in inferring that between birth and death there is absolutely no change in say 699 out of 700 of the numerous characteristics of the markings of the fingers of the same person such as can be impressed by him wherever it is desirable to do so. Neither can there be any change after death up to the time when the skin perishes through decomposition: for example, the marks on the fingers of many Egyptian mummies and on the paws of stuffed monkeys still remain legible. Very good evidence and careful inquiry is thus seen to justify the popular idea of the persistence of finger markings. There appear to be no bodily characteristics other than deep scars and tattoo marks comparable in their persistence to these markings; at the same time they are out of all proportion more numerous than any other measurable features. The dimensions of the limbs and body alter in the course of growth and decay; the colour, quantity, and quality of the hair, the tint and quality of the skin, the number and set of the teeth, the expression of the features, the gestures, the handwriting, even the eye colour, change after many years. There seems no persistence in the visible parts of the body except in these minute and hitherto disregarded ridges." In speaking of the persistence of the marks on the fingers, the phrase must be taken to apply to the details of the ridges and to the general character of the pattern; not to the measure of its length, breadth, or other diameter, these being no more constant than the stature or any other of the ordinary anthropometric data.

Appliances used.—The appliances required are few and inexpensive. Ordinary white paper with the surface not too highly glazed, some printer's ink and a roller for spreading it, consisting of a wooden cylinder 3½ inches long, one inch diameter, over which a piece of rubber tubing has been tightly stretched; at either end of the cylinder brass pins are driven in to form the axle on which the handle works. A piece of flat tin. A pointer, which can be made of a penholder handle, with a needle or sharp-pointed brass wire let in at one end. This pointer is used for ridge counting and ridge tracing. Persons with very good sight are able to dispense with optical aid, but a reading glass such as is used for looking at photographs or reading small print is more or less indispensable, and should always be kept available; for blurred prints a common pocket lens is required. All these articles can be procured through any stationer. A word of caution may be added. The ink, roller, and slab must be kept scrupulously clean and free from dust, grit, and hairs. The ink should be kept in a bottle or other receptacle that can be hermetically closed. The roller when not in use may be kept wrapped up in a piece of clean oiled paper. The slab should be freshly cleaned each day, all particles of old ink being rubbed off.

"Plain," "rolled" impressions—How taken.—Impressions are taken in two ways, as "plain" and as "rolled" impressions. Fig. 1 is an example of the "plain," Fig. 2 of the "rolled"

impression of the same thumb. (By "rolled" here is meant the cylindrical projection of the pattern upon paper.)

To take a "rolled" impression, the bulb of the finger is placed upon a tin slab over which a thin film of printer's ink has been spread, the plane of the nail being at right angles to the plane of the slab, and the finger is then turned over until the bulb surface, which originally faced to the left, now faces to the right, the plane of the nail being again



FIG. 1.



FIG. 2.

at right angles to the slab. By this means the ridge surface of the finger between the nail boundaries is inked, and, by pressing it lightly upon paper in the same way that it was pressed upon the inked slab, a clear rolled impression of the finger surface is obtained. Care must be taken not to press the finger too heavily on the inked slab or subsequently too heavily on the paper, otherwise a blurred or imperfect impression results. To obtain good im-

pressions, the following details must receive attention. The tin slab in use should be free from dust, hairs, or other foreign matter. It should be freshly cleaned each day, all traces of the ink previously used being removed. A very small quantity of ink should be applied, and this should be worked up into the thinnest possible film: unless the film is thin, the impression obtained will not be clear and sharply defined. From a finger so inked a good impression is secured, as even additional pressure will not do much harm. The paper used should be white and its surface not too glazed, for, unless it is sufficiently absorbent, nearly all the ink will remain on the finger, less adhering to the paper, the print resulting not being in consequence sufficiently dark. Good impressions can be taken on ordinary foolscap. Stress is laid upon the paper being white, so as to facilitate the work of photographing, should a photograph of the impression be, at any future time, required. Many kinds of ink have been experimented with, but, on the whole, printer's ink is the most satisfactory, as it is procurable everywhere at trifling cost. The paper being porous absorbs the ink impressed on it by the finger, and, as the principal constituent of this ink is oily matter which readily oxidises under the action of the air, the sheets containing impressions may be at once handled without risk of defacement from smudging. The slab can be made of sheet copper or any other metal; but as tin is the cheapest and most easily procured, it has been generally adopted.

A "plain" impression is obtained by placing the

bulb of the finger on the inked slab and then impressing it on paper without any turning movement.

Reasons for taking "rolled" prints.—Though both operations present no difficulty, taking a "plain" impression is the simpler of the two, and it may be well therefore to explain why a "rolled" impression is required. Referring to Figs. 1 and 2, which are impressions of the same thumb, it will be seen that in Fig. 1 the whole contour of the pattern does not appear, whereas in Fig. 2 the whole pattern is reproduced. Obviously therefore, for reasons hereafter given, it is easier to determine the type of pattern from a "rolled" impression; moreover, the greater surface of the latter enables a larger number of points for comparison to be selected when it is a question of contrasting the details of two prints with a view to deciding whether they are impressions of the same or of different digits.

All impressions divisible into four types.—Innumerable trials have been made with a view to fixing standards or types according to which all impressions can be readily sorted; Purkenje proposed nine, Sir Francis Galton three. As the outcome of much experimenting, a fourfold classification has been adopted which meets all requirements while greatly reducing the number of gradational cases.

These four types are: Arches; Loops; Whorls; Composites.

Definitions are given on page 26 and following pages; numerous diagrams and illustrations being utilised to make the definitions intelligible.

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Fixed points in impressions.—In impressions of the Loop, Whorl, and Composite types there are fixed points which, as will hereafter appear, subserve several useful purposes. These fixed points are :

(1) The "delta" or "outer terminus."

(2) The "point of the core" or "inner terminus."

Delta; "Outer terminus."—The "delta" here referred to may be formed either (*a*) by the bifurcation of a single ridge, or (*b*) by the abrupt divergence of two ridges that hitherto had run side by side.

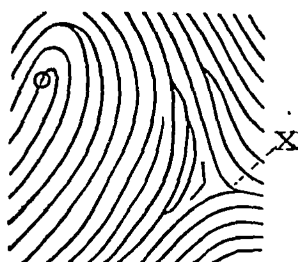


Fig. 3.

(*a*) Where the upper and lower sides of the "delta" are formed by the bifurcation of a single ridge, the point of bifurcation forms the "outer terminus," marked X in Fig. 3. Where there are several such bifurcations, the one nearest the core is taken as the "outer terminus."

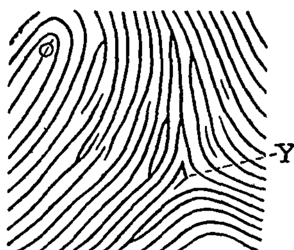


Fig. 4.

(*b*) The upper and lower sides of the "delta" may be formed by the abrupt divergence of two ridges which, up to this point, had run side by side. The nearest ridge in front of the place where the divergence begins, even if it be a mere point, and whether it is independent of or sprung from the diverging ridges or not, is the "outer terminus," marked Y in Fig. 4.

Core; Point of core; Inner terminus.—The core of a Loop may consist either of an even or an uneven number of ridges (termed "rods") not joined together thus :



FIG. 5.

or it may consist of two ridges formed together at their summit (termed "staple"), thus :



FIG. 6.

Where the core consists of an uneven number of rods, the top of the central rod is the "point of the core." If the core is a staple, the shoulder of the



FIG. 7.

staple that is farthest from the delta is taken as the "point of the core," the nearer shoulder counting as a separate ridge. Where the core consists of an even number of rods, the two central ones are considered as joined at their summits by an imaginary neck, and, of these two, the shoulder farthest from the delta is the "point of the core." In Whorls circular or elliptical in form, the centre of the first ring is the

"point of the core." Where the Whorl is spiral in form, the point from which the spiral begins to revolve is the "point of the core." "Point of the core" is synonymous with "inner terminus."

In the above diagrams the first ridge that envelopes the core is dotted.

Illustrations 149 to 164 inclusive have the "inner terminus" (I.T.) and "outer terminus" (O.T.) drawn under each impression. Study of these illustrations will, it is hoped, make the definitions quite intelligible. As explained under *ridge counting*, Loops are differentiated according to the number of ridges which intervene between their "inner" and "outer terminus," these *two terminal points being excluded from the count.*

Arches.—In Arches the ridges run from one side to the other, making no backward turn; there is ordinarily no delta, but, when there is the appearance of a delta, *no ridge must intervene between the "inner" and "outer terminus."* Figs. 8 and 9 present no difficulty.



FIG. 8.



Fig. 9.

In Figs. 10 and 11 [illegible] ridge which has the app[illegible] it might be contended [illegible]





FIG. 11.

of the type of both the Loop and the Arch; but when the above definition is applied, it will be seen that as no ridge comes into count between the two terminal points, they fall within the class of Arches.

The impressions given in illustrations 1 to 12 inclusive are Arches. In Illustrations 13, 14, 15 one ridge, in Illustration 16 two ridges intervene between the terminal points: these impressions therefore are Loops and not Arches.

Tented Arches.—In patterns of the Arch type, the ridges near the middle may have an upward thrust, arranging themselves as it were on both sides of a spine or axis, towards which adjoining ridges converge. The ridges thus converging give to the pattern the appearance of a tent in outline,



FIG. 13.

hence the name Tented Arch (Fig. 13). In order to demarcate clearly the line which separates Tented Arches from those Loops whose ridges have a more or less vertical trend, it is held that, if *on either side of the axis even one ridge recurves*, the impression is a Loop (Fig. 12.) The meeting of two ridges at a sharp angle resulting from their running into each other through not maintaining their parallelism of direction, is not to be confused with recurving. The recurving ridge must be wholly on one side of the axis. Illustrations 17 to 24 inclusive are Tented Arches. Illustration 25 has one recurving ridge to the right of the axis; Illustration 26 has one to the left (some converging ridges may be noticed in this impression); Illustration 27 has two recurving ridges, to the right of the axis, so these impressions 25, 26, and 27 would be classed as Loops.

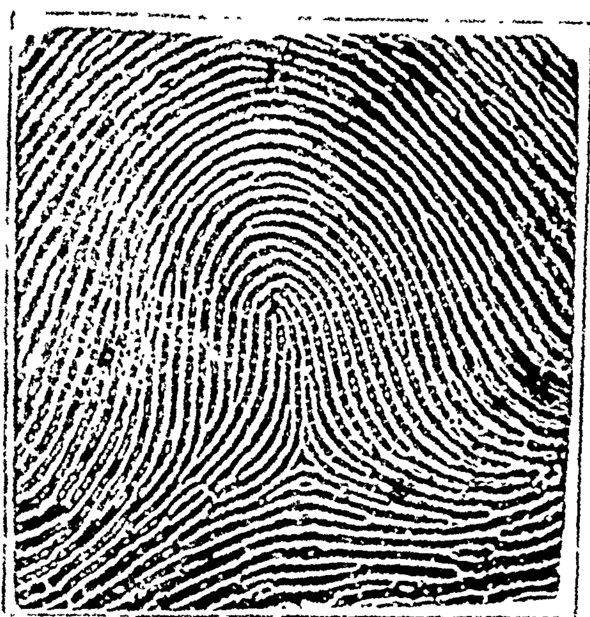


FIG. 12.

Loop.—In Loops some of the ridges make a backward turn but without twist; there is one delta (Figs. 14, 15).

In Fig. 15 the ridge, or, if it be likened to water, the stream A X bifurcates into X C and X D. X C at first follows an upward course, and, having reached its greatest height, trends downwards, passing away to the left side, while X D proceeds generally in the direction followed by A X; there is one delta, namely, at X. The trend of the ridges about the core, *i.e.* the direction from their summit to their exit between C D, is a slope from the right of the person looking at them towards his left.

In Fig. 16 some of the core ridges meet an enveloping ridge at an acute angle; compare Illustrations 44, 45, 46, 47, 48, 49. In Fig. 17 the

summits of the ridges are deflected slightly downwards ; compare Illustrations 35, 36, and 39.

The Illustrations 28 to 49 inclusive exhibit many varieties of Loops, and may be studied with advantage.

Ulnar and Radial.—When seen in a looking-glass, the right hand appears as a left hand, the right eye as a left eye, the right half of the body as a left half. Similarly, the print of a finger is a reversal of the pattern on the finger ; if this pattern on the finger be a Loop with slope from left to right, it will appear in the print as a Loop with slope from right to left. If a finger print impressed on transparent paper be held in front of two persons facing each other, the pattern as seen by the one will be a reversal of the pattern as seen by the other ; all the details of the print will of course correspond, but to the one observer the ridges which lie to the left of a central line will to the other observer appear to lie to the right. This is precisely what occurs when the same pattern exists on corresponding fingers of the two hands, as may be seen by taking prints from the two fingers, when it will be observed that one print delineates a pattern which is a reversal of the pattern delineated by the other. This has to be borne in mind in determining whether a Loop is *ulnar* or *radial*. A Loop is *ulnar* = U when the downward slope of the ridges about the core is from the direction of the thumb towards that of the little finger. It is *radial* = R when the downward slope is from the direction of the little finger towards the thumb.

The following rule may always be usefully applied. When the print under examination is that of a right hand digit, place the right palm on the table ; if the downward slope of the ridges about the core is from the thumb side towards the little finger the Loop is *ulnar*, if the slope is from the direction of the little finger towards that of the thumb it



FIG. 14.



FIG. 15.

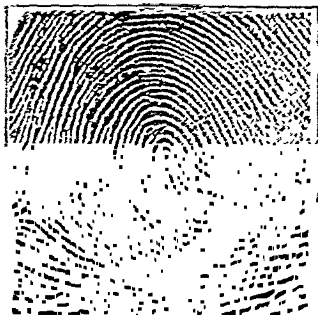


Fig. 15.



Fig. [illegible].

is radial. If the print is one of a [illegible] place the left part [illegible]

reversed for the left hand, where / = *ulnar* and \ = *radial*.

If the impressions of Figs. 14 and 15 are those of left hand digits, they are *ulnar* Loops; if of a right hand they are *radial*. Referring to the Illustrations, if they are impressions of a right hand digit, 31, 32, 35, 37, 42, 46 are *ulnar* Loops, 30, 33, 34, 38, 39, 40 being *radials*. If they are impressions of a left hand, 31, 32, 35, 37, 42, 46 would be *radial*, and 30, 33, 34, 38, 39, 40 would be *ulnar*.

As it is essential to have this differentiation well understood, the point is dwelt upon. The terms *ulnar* and *radial* are borrowed from anatomy, the ulna and radius being the two bones of the forearm.

Whorls.—In whorls some of the ridges make a turn through at least one complete circuit; there are two deltas. Whorls are single cored or double cored (Figs. 18, 19, 20, 21, 22, 23).

In Fig. 18 the ridge or stream A Y bifurcates at Y, the stream Y B making an upward turn before descending, while the stream Y C passes away towards the right side, this bifurcation causing the appearance of a delta at Y. On the right side of this same diagram the stream D Z, which flows from right to left, bifurcates at Z, causing the appearance of the delta there; the stream Z E at first flows upwards before taking a downward course, while the stream Z F, continuing in the direction of the parent stream D Z, passes away to the left.

In Fig. 20 the ridges about the core are elliptical

in form Fig 21 exhibits a single spiral Whorl, Fig 22 a double spiral Fig 23 is that of an impression which, for want of a better term, may be called almond-shaped In some patterns the spiral appears to revolve in the same direction as the hands of a watch, in others this revolution is

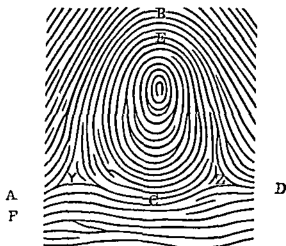


Fig 18



Fig 19

in the opposite direction; great variety is noticeable in the cores; and very many details force themselves upon consideration when two impressions of this type are being compared.



FIG. 20.

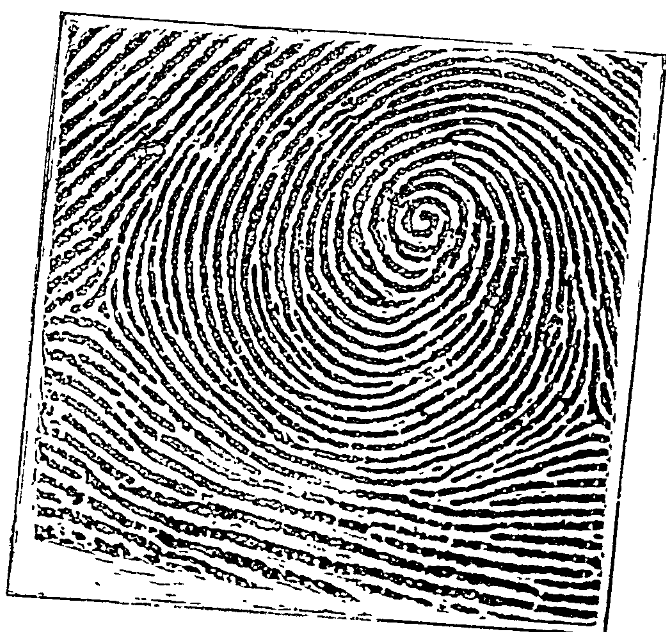


FIG. 21.



Fig 22.



Fig. 23.

Varieties of the Whorl type will be found delineated in Illustrations 101 to 124 inclusive.

Composites.—Under Composites are included patterns in which combinations of the Arch, Loop, Whorl are found in the same print, also impressions which might be deemed to present features requiring their definition as being Loops in respect of the majority of their ridges and Whorls in respect of a few ridges at the centre or side. These are subdivided into Central Pocket Loops, Lateral Pocket Loops, Twinned Loops, Accidentals.

Central Pocket Loops.—It not infrequently happens in patterns of the Loop type that the ridges immediately about the core deviate in course from the general course of the other ridges. Such impressions may therefore be said to possess features which require their being defined as Loops in respect of the majority of their ridges and Whorls in respect of the appearance of the few ridges which occupy a space immediately about the centre, a delta more or less faintly defined having in consequence made its appearance. Upon the analogy of a nomenclature adopted in mining, the space so occupied by ridges whose course deviates from the course of the ridges surrounding them is described as a "pocket," and the impression as a Central Pocket Loop (Figs. 24 and 25).

All varieties of the Central Pocket type can be arranged under one or other of the forms of core shown in Fig. 26. These four standards overlap; II. is obviously only a modification of I., and III. a more complete form of IV. The arrow marks the position of the axis or line of exit of the ridges. Examining

the standards, it will be noticed that this arrow if prolonged would meet at least one recurving ridge at right angles. This characteristic determines in doubtful cases whether an impression is a Loop or Central Pocket. These standards have been adopted to guide the eye, and because their employment often proves of assistance in at once deciding whether an impression is or is not a Central Pocket.

Illustrations 71, 72, 73, 74 come under Standard I.; in 75, 76, 77, 78 the axis meets ridges not at right angles but at an acute angle, and they moreover are converging not recurving edges, so these impressions are excluded from Central Pockets and classed as Loops. Illustrations 79, 80, 81 come under Standard II. In Illustrations 82, 83, 84, 85 the ridge or ridges meet the axis at an acute angle; these impressions are classified as Loops. Standard III. possesses characteristics which can at once be noticed when they exist in an impression.

Standard IV. is the most comprehensive and most easily applied. The existence of even one ridge whose course is at right angles to the axis brings the impression under this standard. Illustration 97 is a good example of this. There occasionally occur cases in which the application of the rule may appear doubtful and these [illegible] treated as transitional and when search [illegible] must be made first on the assumption that the impression is a Loop and then on the assumption that it is a Composite [illegible] dealt with under Classification.



Fig. 24.



Fig. 25.

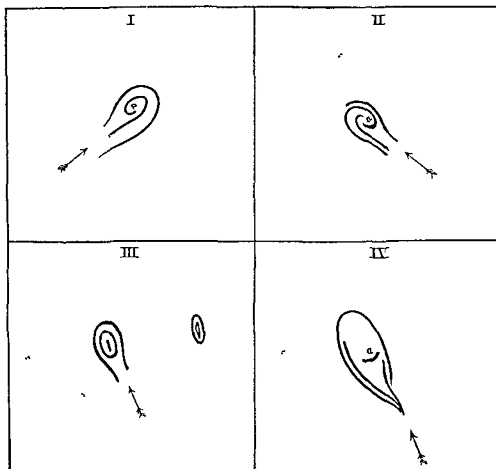


Fig 26

Lateral Pocket Loops.—When the ridges constituting the Loop bend sharply downwards on one side before recurving, thereby forming on that side an interspace or "pocket," ordinarily filled by the ridges of another Loop, such impression is termed a Lateral Pocket Loop.

In Fig. 30A compare 1, 2, 4, 5 ; the outline of the Loop, whose ridges bend down sharply, is shown by the dotted lines. the thick dark line (*a*) represents its central ridge, the dark line (*b*) representing the central ridge of the Loop where ridges occupy the

pocket. See also Figs. 27, 28, 29, 30, also Illustrations 50 to 57 inclusive. It should be realised that the ridges which bend downwards must be recurving not converging ridges—that their contour when they recurve must be rounded not angular. These ridges in Illustrations 58 to 65 inclusive converge, that is, they meet at an angle, and their contour in consequence is angular not rounded, hence the impressions would be classified as Loops *ulnar* or *radial* and not as Lateral Pockets.

Twinned Loops and Lateral Pockets differentiated.—Referring to Figs. 31 and 32 and Illustrations 66, 67, 68, 69, 70, it will be seen that this at first sight complicated pattern in reality consists of two well-defined Loops, one superincumbent on or surrounding the other. Such an impression is termed a Twinned Loop.

Many Twinned Loops appear to be almost identical in contour and in details of ridge grouping with Lateral Pockets. Fig. 30A contains patterns which make clear the distinction which exists. The dark lines, marked *a*, *b*, are the central ridges of the two Loop systems, the ridges which contain the "points of the core." In 1, 2, 3, 4, 5, Fig. 30A, these ridges *a*, *b* have their exits on the same side of the right hand delta. In 6, 7, 8, 9 these ridges have their exits on different sides of the right hand delta. The following distinction therefore differentiates Lateral Pockets from Twinned Loops. In Lateral Pockets the ridges containing the "points of the core" *have their exits on the same side of the*

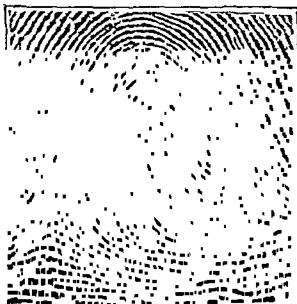


FIG. 27



[illegible]

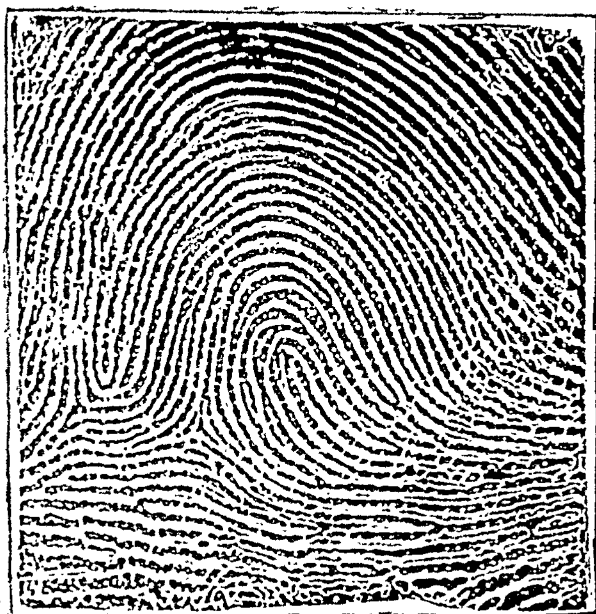


FIG. 29.

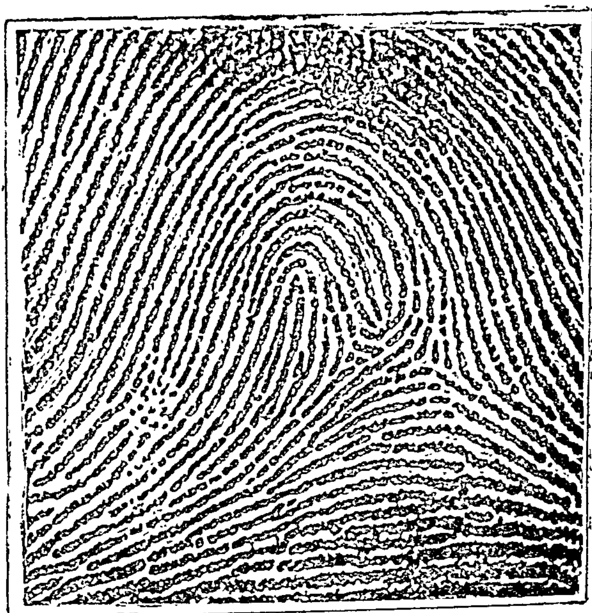
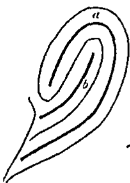
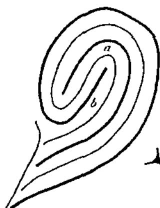


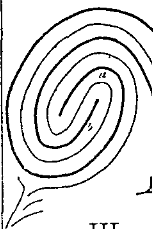
FIG. 30.



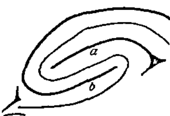
I



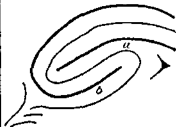
II



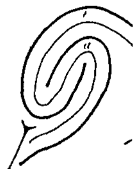
III



IV



V



VI



VII





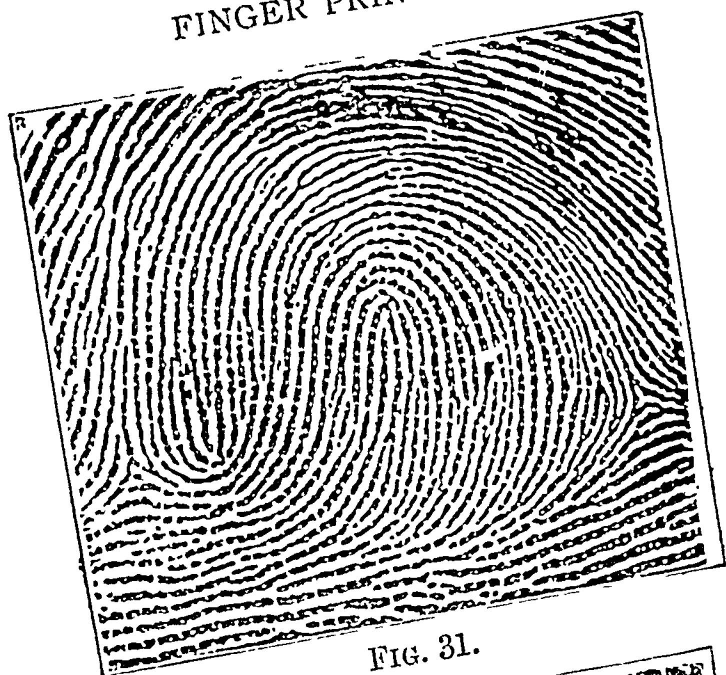


FIG. 31.

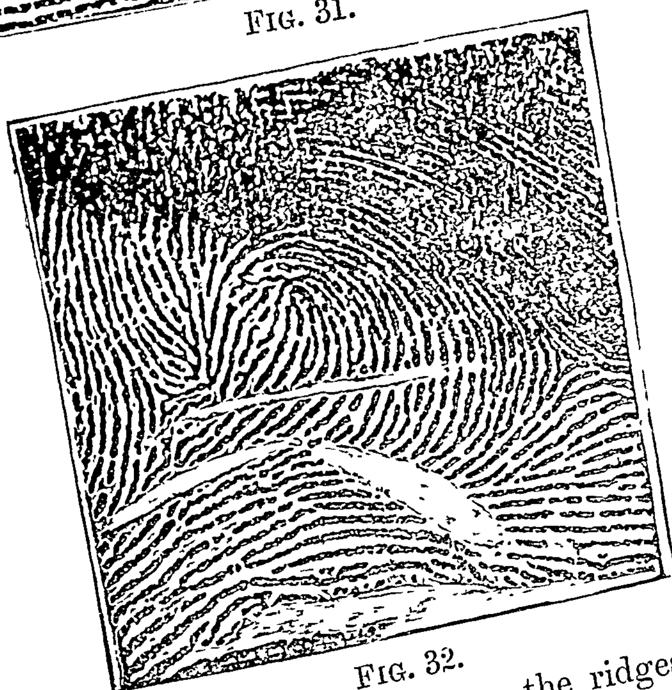


FIG. 32.

right delta; in Twinned Loops the ridges containing the "points of the core" *have their exits on different sides of the right delta.* Both types of pattern are, as already stated, included under Composites, and further differentiation may appear unnecessary; but in practice it will be found very useful

to have such a clear distinction between patterns which in general appearance closely resemble each other.

Accidentals.—Under Composites are also included the relatively small number of patterns too



FIG. 33.



FIG. 34.



Fig. 35.



Fig. 36.

irregular in outline to be grouped under Central Pockets, Lateral Pockets, or Twinned Loops ; they are termed in the absence of a better nomenclature,

Accidentals (Figs. 33, 34, 35, 36 and Illustrations 125 to 132 inclusive). Fig. 33 might be described as an Arch with pocket. Fig. 34 at first sight, appears to be a Whorl surrounded by a Loop ; Illustration 127 to be a Whorl resting on a Loop ; 130 a Loop resting on a Whorl ; but more strict examination shows that such descriptions lack accuracy, and it is better *therefore to group these varieties into* subclass Accidentals of class Composites.

Ridge counting.—As about two impressions out of every three are Loops, the subdivision into *ulnar* and *radial* fails to split them up into groups sufficiently small, and it is necessary therefore to still further differentiate them by other methods.

Fig. 37 represents the ridges of an ordinary Loop. The line S B joins the two terminal points, "inner" and "outer terminus." If the ridges which cut the line S B are *counted* they will be found to number 17, so this Loop is specialised as a Loop with 17 ridges or *counts*, and if it is the impression of a right hand digit it would be further specialised as an *ulnar* ; if of a left hand digit as a *radial* Loop.

In ridge *counting* it must be remembered that the *two terminal points are excluded from count*, that ridges like G, which run close up to without meeting the line S B are also excluded, and that when two ridges result from a bifurcation as at D, close to the line S B, both are counted. A little practice will enable anyone with the help of a read-

ing glass and a pointer to *count* ridges accurately and quickly.

Illustrations 149 to 164 inclusive may be studied; the "inner" and "outer terminus" are figured below

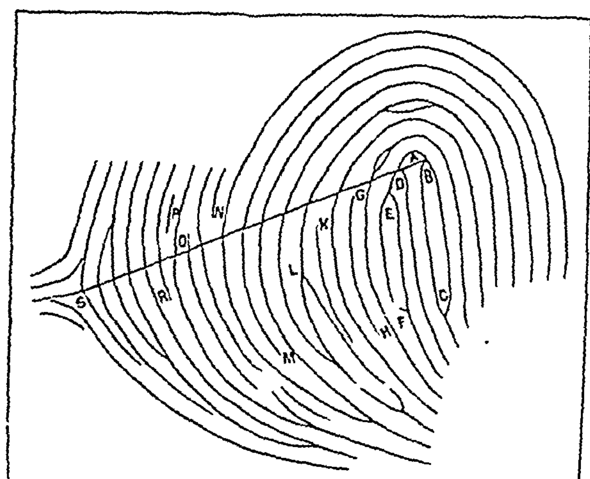


FIG. 37.

each impression, and the number of *counts* is given.

Ridge characteristics.—If Fig. 37 be again more closely examined, many other details of the ridges will be noticed. The "core" is a "staple" whose right limb bifurcates at B, and whose left limb bifurcates at D and again at E. In the ridge which immediately surrounds the core ridge is a small island to the left of D, and another in the third surrounding ridge directly above A. These islands come out clearly in the diagram, but in actual impressions they might appear as a bulging out or thickening of the ridge, due to the ink running. At G the ridge begins abruptly and ends abruptly at H, at K another ridge begins abruptly, at L another ridge bifurcates, at O another ridge begins abruptly. And

there are many other similar details. These abrupt beginnings and endings, islands, bifurcations, etc., are known as ridge *characteristics*. Each marked departure from the general system of reticulation may be thus utilised.

Whorls and Composites present such innumerable varieties of pattern and of *characteristics* that when two whorls are compared no difficulty is experienced in determining whether they are impressions of the same or of different fingers. But as it proves convenient to have them subdivisible into regular groups, the system employed may be described.

Ridge tracing.—In all impressions of the above two types there are two deltas, one to the left and the other to the right. These deltas are formed either by the bifurcation of a single ridge, or by the sudden divergence of two ridges that up to this point had run side by side. Taking the lower limb or lower ridge of these two, its course is followed, and it will be found either to meet to go inside or go outside the corresponding ridge of the right delta. When the ridge whose course is being *traced* stops short, the course of the ridge next below it is followed; when the ridge bifurcates, the *tracing* proceeds along the lower line of bifurcation. When the ridge whose course is *traced* meets the corresponding right delta ridge the Whorl is specialised as M.; when this ridge goes inside, it is specialised as I; when outside as O.

To secure an even distribution of I, M, O Whorls it has been found necessary to provide that if

the ridge whose course is *traced* goes inside or outside the right delta ridge with not more than two ridges intervening between them, such ridge is considered as though it actually met the corresponding ridge. I therefore means that the left delta ridge goes inside the right delta ridge, there being between them not less than three intervening ridges ; O means that the left delta ridge passes outside the right delta ridge, not less than three ridges intervening ; and M means that the ridge whose course is *traced* actually meets the corresponding ridge, or that they are not apart by more than two intervening ridges. The definitions will be readily understood from the drawings below, where the ridge course *traced* is marked by the arrow head. See Illustrations 133 to 148.



=





M =



=





Fig. 38.

Summary of Preceding Paragraphs.

What has been stated in preceding pages may now be briefly summarised. The palmar surface of the hand and the sole of the foot are traversed by innumerable ridges, forming many varieties of

pattern, and by creases. The ridge patterns and the ridge *characteristics* persist throughout the whole period of human life, and are so distinctive as to differentiate each individual from all others. An accurate reproduction of these ridges is obtained by inking the finger bulb and pressing it on paper, the impression thus recorded being a reversal of the pattern on the finger. All impressions may be arranged under one of four types, namely, Arches, Loops, Whorls, Composites. Arches subdivide into Arches and Tented Arches; clear definitions demarcate Arches from Tented Arches, and both from Loops. Loops may be *ulnar* or *radial*, and are further differentiated from each other by ridge *counting* and by their ridge *characteristics.* Whorls are single or double cored; impressions of this type differ conspicuously from each other, owing to the innumerable varieties of pattern they present, but further demarcation is provided by ridge *tracing*. Composites include Central Pockets, Lateral Pockets, Twinned Loops, Accidentals; the definitions given are sufficient for the accurate differentiation of these subclasses.

In impressions there are fixed points known as "inner" and "outer terminus," whose correct position is readily found. These fixed points serve many useful purposes, including ridge *counting*, ridge *tracing*, and the orientation of patterns.

Symbols used.—The symbols used are A = Arch; T = Tented Arch; L = Loop; W = Whorl; C = Composite; L P = Lateral Pocket; T L = Twinned Loop; C P = Central Pocket; Ac = Accidental; I T

= "inner terminus"; O T = "outer terminus"; U = = *ulnar* in right hand; R = / = *radial* in right hand; U = ⁄ = *ulnar* in left hand; R = \ = *radial* in left hand.

Instance of practical use of system.—The facts of a notorious criminal case decided in the Bengal Courts in 1898, after a somewhat protracted inquiry, illustrate how the information afforded by finger prints may be utilised in practice.

"The manager of a tea garden situated in the district of Julpaiguri on the Bhutan frontier was found lying on his bed with his throat cut, his despatch box and safe having been rifled and several hundred rupees carried away. It was suggested that one of the coolies employed on the garden had committed the deed, as the deceased had the reputation of being a hard taskmaster, or that his cook, upon whose clothes were some blood spots, might be the culprit. There was suspicion also against the relatives of a woman with whom the murdered man had a *liaison*, also against a wandering gang of Kabulis of criminal propensities who had lately encamped in the neighbourhood. A representation was also made that the deceased had an enemy in an ex-servant whom he had caused to be imprisoned for theft. Inquiry, however, satisfied the police that there was no evidence to incriminate the coolies or the relatives of the woman or the Kabulis, and it was ascertained that the ex-servant had been released from jail some weeks before, and no one could say that he had since been seen in the

district. The cook's statement that the marks on his clothes were stains from a pigeon's blood which he had killed for his master's dinner was supported by the Chemical Analyst's report. Fortunately amongst the papers in the despatch box was found a calendar in book form, printed in the Bengali character, with an outside cover of light-blue paper on which were noticed two faint brown smudges. Under a magnifying glass one smudge was decipherable as a portion of the impression of one of the digits of some person's right hand. In the Central Office of the Bengal Police, the finger impressions of all persons convicted of certain offences are classified and registered, and the impression on the calendar when compared there was found to correspond exactly with the right thumb impression of Kangali Charan, the ex-servant above referred to. He, in consequence, was arrested in Birbhum, a district some hundreds of miles away, and brought to Calcutta, where his right thumb impression was again taken, and the police in the meantime set about collecting corroborative evidence. The Chemical Examiner to Government certified that the brown marks on the calendar were mammalian blood, the inference being that the actual murderer or some associate had knocked his blood-stained thumb against the calendar when rummaging amongst the papers in the despatch box for the key of the safe. The accused was committed to stand his trial before a judge and assessors, charged with murder and theft, and finally was convicted of having stolen the missing property of the deceased, the assessors

holding that it would be unsafe to convict him of murder, as no one had seen the deed committed, but recording their opinion that the charge of theft had been conclusively established against him. This conviction was upheld by the judges of the Supreme Court, to which the case was taken on appeal."



FIG 39.



FIG. 40



Fig. 41.

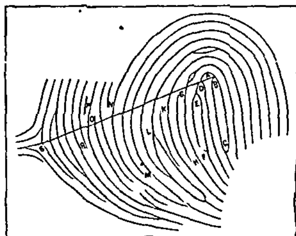


Fig. 42.

Figs. 39, 40, 41 are copies of the enlargements made from the actual marks by the Survey of India, placed before the Courts that tried the case, and proved in the usual way. Fig. 42 is a drawing by hand to show the ridge *characteristics* relied on ; they

are marked by the small capital letters, and are fully described.

They appear in all three impressions—in the blood print on the calendar (Fig. 41), in the print on record in the Central Police Office (Fig. 39), and in the print taken from Kangali Charan's thumb after his arrest (Fig. 40). What probative value shall we assign to such distinctive similarities being found in three prints made at intervals of time, and what inference are we in the circumstances of this particular case justified in drawing? The question is of such importance that some space may be devoted to discussing it.

Probative significance of existence in two finger prints of distinctive similarities.—It is known that many of the constituents of the sun and stars have been determined by spectroscopic analysis of the light from them which comes to us as a message through space. Transmitted through a glass prism, light so simple in appearance, but in reality complex in its nature, is resolved into its constituent rays, these appearing as bands of various colours with narrow gaps wanting in brightness which show out as dark lines traversing the colours of the spectrum. For nearly half a century after their first discovery by Fraunhoffer their significance was not apprehended, and it was only in 1859 that Kirchhoff proved the dark lines of the spectrum to be caused by the absorbing power of a vapour screen of the same substance which when sufficiently heated gives out the bright lines.

This discovery provided the key which has enabled astronomers to solve many problems which hitherto had baffled them The spectra of earthly elements having been mapped out, it was possible to compare them with the spectra of the sun and stars, and then marked coincidences in the number, position, and groupings of these lines became apparent By what process of reasoning are such coincidences held to establish the identity of the sources producing these coinciding lines? The answer is given in the published results of Kirchhoff's investigations On comparing the spectrum of sunlight and of light from incandescent iron vapour, he found a considerable number, sixty or more bright lines in the spectrum of iron coinciding with dark lines in the solar spectrum Taking the average distance between these lines as they show on his map, and making allowance for their apparent breadth, he considers the probability to be $\frac{1}{2}$ that an iron line thrown down by chance will appear to coincide with a solar line The probability of casual coincidence of each iron line with a solar line is similarly $\frac{1}{2}$. The probability therefore of coincidence by chance of all sixty iron with the sixty solar lines is $\frac{1}{2}$ multiplied by $\frac{1}{2}$ fifty-nine times or $(\frac{1}{2})^{60}$ Otherwise expressed, the odds against these coincidences occurring by chance is more than a trillion to one On the supposition, however, that iron exists in the sun, it is certainly probable that such coincidences would be found[1]

This argument is held to establish with a proba-

[1] Kirchhoff, *Researches on the Solar System*

bility little short of certainty the existence of iron in the sun. Many other conclusions of astronomy are based upon a similar application of the theory of probability.

Upon like grounds we believe in the human origin of flint heads. For though the actual concussion of one flint against another may produce flakes, yet when several such flint heads are found in the same spot, each bearing evidence of many blows similarly directed, conducing to fashion a lance or spear-head form, the probability of a natural origin becomes extremely small, and the supposition that they are the handiwork of men almost a certainty.

We may now apply this line of reasoning in estimating the probability of specified *characteristics* found in the impression of one digit occurring by chance in that of any other. Taking Fig. 42 and assuming it to be three chances to one against the bifurcation B occurring casually in this particular limb of a "staple" and at this particular point of it in another impression selected at random, the probability of such occurrence is $\frac{1}{4}$. The degree of probability here assigned is, it will be conceded, not excessive, for there might be no bifurcation, or if there happened to be a bifurcation it might be in some other position of the limb. Similarly, the probability of bifurcations at D and E occurring by chance is $\frac{1}{4}$ for each; the probability of a ridge beginning abruptly at G may be put down at $\frac{1}{4}$; of its ending abruptly at H at $\frac{1}{4}$; of ridges beginning abruptly at K, M, N, each at $\frac{1}{4}$; the chance of another impression being an *ulnar* Loop with a

"staple" for core at $\frac{1}{4}$; and finally, the probability of a second impression having just 17 ridges intervening between its "inner" and "outer terminus" at $\frac{1}{4}$, and so on. Confining our attention to the *characteristics* specially noticed, the probability of all ten occurring by chance in the impression of any other digit is $\frac{1}{4}$ multiplied by $\frac{1}{4}$ nine times, or $(\frac{1}{4})^{10}$. In other words, the odds against all these similarities being found in two impressions, not those of the same digit, is over a million to one. Upon the other hypothesis that they are prints of the same digit it is highly probable that such coincidences would occur, and clearly it is immensely more probable that these ten coincidences in the *characteristics* of the ridges should be found if the impressions are those of the same digit than that they should occur by chance. Figs. 39 and 40 are prints from the same thumb, the one taken in 1895, the other in 1897; they show all the *characteristics* which have been enumerated, and these same *characteristics* are found in the blood print on a calendar, proved to have been in the possession of the deceased from the time of its issue.

It may happen that circumstantial evidence of apparently overwhelming completeness will sometimes lead to a mistaken judgment, but every Court has to act upon probabilities, for if certain evidence, in the strict meaning of the words, were required, no punishments could be inflicted. While, then, realising the importance of carefully distinguishing between the truth of a theory and its truthful application to the facts of a case, can there

in this instance be any doubt that the blood print on the calendar is the thumb impression of Kanglia Charan ?

In the investigation of burglaries the following, selected from recent cases which have occurred in the Metropolitan Police district, afford a useful lesson of the value of keenly inspecting all articles touched by the thief, with a view to the discovery of finger prints.

On the 17th August, 1904, a thief entered No. 30, St. Peter's Square, Hammersmith, and, before leaving, helped himself to a glass of wine. On the tumbler used the thief left two finger prints, and these were subsequently found, upon search in the Record at New Scotland Yard, to be identical with two of the finger prints of one, George Gage, a notorious criminal.

Gage was subsequently arrested and committed for trial. He pleaded guilty, and was sentenced to four years penal servitude.

The case is reported at length in the *Daily Telegraph* of the 21st October, 1904.

On 29th November, 1904, a burglary took place at No. 5, Crisp Street, Poplar. The entry was effected by means of removing a pane of glass from the basement window. On the glass taken from the window-frame were the imprints of a right forefinger, right middle finger, left thumb, left forefinger, and left middle finger, all in their natural sequence.

The patterns of the imprints were those of *ulnar* Loops, with the exception of the left thumb, which was a Whorl. There was also a distinct Whorl

imprinted on the glass, and by its size it was thought to have been made by a thumb. Amongst the files searched was $\frac{5}{17}$, which is the formula when both thumbs are Whorls and the remaining digits Loops, and in it the finger prints of one Walter Rose were found to agree exactly with the impressions left on the glass.

The officer in the case was at once informed of the discovery, when he proceeded to Rose's address and arrested him. Some of the stolen property was found at his abode.

In this case only a few hours elapsed after police were informed of the burglary before the thief was located and arrested with the stolen property in his possession. Rose pleaded guilty.

This case is reported in the *Morning Advertiser* of 21st December, 1904.

In 1905 a man and his wife were murdered in their bed at a house in Deptford, London. They were in the habit of placing their money each night in a small cash-box kept under a pillow of the bed. After the murders the cash-box was found in the bedroom broken open and the money gone. On the side of its inner tray was a faint digital mark which was immediately photographed.

Subsequently two brothers named Stratton were arrested on suspicion, it being known to Police that they were in the locality about the time the murders were committed. Their finger prints were taken, and the right thumb print of one of the brothers was found to be identical with the mark on the cash-box.

PART II.

PART II

Introduction of Anthropometry.—The importance of being able to fix human personality, of being able to give each human being an individuality differentiating him from all others, under conditions which will ensure that this individuality can be convincingly and quickly ascertained in spite of all efforts that may be made to confuse it, cannot be overestimated. The problem of providing the necessary data was first dealt with successfully in France. M. Bertillon's inquiries having satisfied him that the measurements of certain bony portions of the human frame do not vary during the period between adolescence and extreme old age, he selected head length, head breadth, middle finger length, foot length and cubit, and distributed them as belonging to one or other of three equally numerous classes, "Small," "Medium," "Large." Consequently there are 243 principal headings, under some one of which the card containing each persons measurements is, in the first instance, sorted. Each of these primary headings is successively subdivided on the same general principle, according to height, span, length, and breadth of the ear, height of the bust, and eye colour, this latter

providing seven divisions. In theory, therefore, the number of subdivisions is $3^{10} \times 7$, which represents a number far in excess of requirements. The measurements are taken with instruments, and it is claimed that they can be taken with great accuracy. The system was first practically worked in France in 1883, and soon began to yield such gratifying results that it has since, in a more or less modified form, gradually been adopted by most countries. It represents a scientific solution of what had long been deemed an insoluble problem, and is obviously an enormous improvement upon all rough-and-ready means previously adopted, one of the best known and most successful of which was that of indexing persons according to tattoo marks. Many belonging to the criminal classes are addicted to the practice of having their arms and bodies tattooed, and this fact was turned to account by the police authorities, who started a tattoo index, which, on the whole, has rendered them much useful help.

In March, 1892, anthropometry was introduced into the large province of Bengal, where, as the outcome of much experimenting, it was found desirable to modify the system by taking only six instead of ten measurements, not noting the eye colour, there being little variation in the pigment of the iris amongst orientals. It was found necessary to use instruments which, by mechanical appliances, had been rendered automatic in their working, the pressure being applied by a spring and kept constant, and a self-registering index being supplied. This

modified system spread to the rest of India, and by the end of 1898 nearly 200,000 cards had been collected in the several provinces. In Bengal, where it had been longest introduced, certain weaknesses in the system showed themselves so detrimental to successful working that attention was directed to the feasibility of substituting a system of identification by finger prints only, not supplemented by measurements. The main difficulty experienced was that of classification. The system suggested by Sir Francis Galton had been examined by the Special Committee appointed by Mr. Asquith when Home Secretary in 1894, and they, while recognising its many excellences, were of opinion that it failed to deal as effectively as Bertillonage with primary classification. In consequence, they recommended the introduction of a dual system, under which primary classification should be according to measurements upon M. Bertillon's principles, finger impressions being utilised for secondary or subclassification. Their recommendation was approved and the dual system introduced, and remained in force until 1901, when, as explained, the system of identification by finger prints only not supplemented by measure was brought in.

Anthropometric and finger-print systems compared.—By the beginning of 1897 the experiments made in Bengal with the system of identifying by finger prints only, proved so satisfactory that an application was made to the Government of India for the appointment of an independent committee to inquire into and report upon the system.

The strong and weak points of anthropometry and the new system were thus compared:

Anthropometry.	*Identification by Finger Prints.*
(1) Instruments are costly, and liable to get out of order.	(1) Accessories needed, a piece of tin and some printer's ink, are inexpensive and procurable everywhere.
(2) Measurers must be put through a special course of instruction and be possessed of sufficient education to understand the significance of the figures of the decimal scale.	(2) Any person, whether educated or not, after half an hour's practice, can take legible finger prints.
(3) If measurements are inaccurately taken, or accurately taken but wrongly read off or wrongly transcribed, the error cannot afterwards be discovered and remedied in the office where the cards are permanently kept, and this error will persist and defeat all chance of successful search. If the data recorded are incorrect, no amount of care can afterwards remedy the defect.	(3) Finger prints are absolute impressions taken from the body itself under conditions which eliminate error as regards transcription or recording. An effective device is adopted to guard against their being imprinted in a wrong sequence. After the "rolled" impression of each digit is taken separately, the digits are confined together in a metal guard and impressed simultaneously as "plain" impressions, thereby securing their occurrence in a correct sequence, and these "plain" impressions are compared with the "rolled" impressions at the time of classification. They may get incorrectly classified, but this error will be subsequently rectified, as it must be noticed during some subsequent search.

Anthropometry	*Identification by Finger Prints*
(4) Recording measurements takes much time, as to ensure reliability each measurement should be taken three several times and the mean result only accepted. Marks and scars are noted, and this necessitates the body being uncovered. The measurements of young persons who have not attained full physical growth alter as they approach maturity.	(4) The impressions of the ten digits can be taken in less than one quarter the time needed for measuring. No record of marks and scars is required, consequently the subject has not to divest himself of his clothes. The patterns of impressions and the ridges of which they are composed retain their peculiarities absolutely unchangeable throughout life.
(5) A margin, greater or less, must always be allowed for errors on the part of the operator for what may be termed the "personal equation" error of operators. This makes search for duplicates particularly onerous. For instance, when a card with length of head 18·4 is received, it is necessary to assume that the operator may have gone wrong within two millimetres (a millimetre being about $\frac{1}{25}$ of an inch) either in excess or defect, and search accordingly is made between 18·6 and 18·2, but the former measure may fall under limit "long" and the latter under limit "medium," *i.e.* two pigeon-holes must be examined. Similar allowance has to be made in respect of	(5) No allowance for error on the part of the operator is made or needed. Working results in India show that, in 1898, 500 anthropometric references necessitated 4623 pigeon-holes being searched, whereas 500 finger impression references in 1899 necessitated only 707 pigeon holes being searched. Under the latter system, on an average, search was exhausted by the examination of 1½ pigeon holes, the extension of search beyond the one pigeon-hole indicated being made to discount any possible variation in classification, while, under the former, more than 9 pigeon holes had to be searched. The records were approximately equal in volume.

substituted. In India the Criminal Record in 1911 consisted of 1,217,632 sets of impressions. In England it, in 1912, contained about 190,000 slips.

The following table gives working results since 1907:

Recognitions effected by the finger-print system since its introduction in countries from which returns have been received:—

—		1907.	1908.	1909.	1910.	1911.	1912.
England		7,701	9.440	9,960	10,848	10,468	10,677
India	Baroda	22	52	72	79	104	
	Bengal	1.938	2,231	2,536	2,473	3,010	
	Bombay	1,148	1,602	1,682	1,710	1,751	
	Burma	875	1,100	1,337	1,585	2,397	
	Central India ...	83	161	216	215	185	
	Central Provinces...	243	572	386	638	574	
	Eastern Bengal and Assam.	126	195	186	200	271	
	Hyderabad "Deccan."	1,064	1,124	2,302	2,178	2,522	
	Madras	1,495	1,867	2,019	2,390	2,446	
	Mysore	323	866	429	301	256	
	Punjab	2,160	2,173	2,899	3,170	4,106	
	Rajputana	153	169	167	178	220	
	Sind...	773	985	1,001	1,083	1,318	
	United Provinces ...	2,295	2,520	2,512	2,435	2,656	
	Central Finger Print Bureau, Simla.	1,333	1,949	2,246	2,193	2,735	
South Africa	Transvaal ...	2,063	2,820	6,453	7,101	8,338	
	Natal	18,425	18,474	16,188	13,798	12,220	
	Orange River Colony.	1,305	1,547	1,770	2,418	2,736	
Australia	New South Wales.	568	862	1,065	1,156	1,164	
	Queensland ...	46	71	82	116	137	
	Victoria ...	—	50	99	97	124	
New Zealand		104	123	138	140	148	
Ceylon		—	—	—	103	238	
Northern Nigeria		—	—	—	—	30	
Straits Settlements ...		659	979	1,129	—	—	
Ireland		178	124	135	145	116	
Brussels		—	—	—	—	60	
Berlin		197	318	402	560	487	
Buda Pesth		—	—	256	388	414	
Copenhagen		—	—	—	159	164	
Christiania		—	—	—	179	318	
Chicago		576	1,633	2,222	2,073	1,758	
Leavenworth, Kansas ...		—	—	—	376	802	1,044
New York City		—	—	—	—	1,500	
Washington...		—	—	—	—	92	
San Francisco		—	—	—	—	65	
Munich		—	—	—	83	216	
Vienna		509	599	663	770	746	

As previously explained, the number of recognitions effected must depend upon the limitation or extension of the system. In England and India, and the Transvaal, only those persons are finger printed for criminal purposes who have been convicted of the more serious offences against property or the person and property. In Natal, the system has been extended in the case of natives to nearly all minor offences, consequently the number of recognitions is very large.

There seems no reason to doubt that the progressive success here shown will be maintained, since it is due to the greater effectiveness of the new system. Innumerable instances have come to notice of recognitions effected by finger impressions which could not have been made out from the anthropometric data supplied, the original measurements recorded and those subsequently taken exhibiting variations so great as to frustrate all chance of successful search. As before explained, there must be a residuum of error attributable to what may be termed the personal equation of the measurer, however well devised the checks may be, or however good the instruments used. The operator may be slack and not take the measurements with sufficient care, or having taken them correctly he may transcribe them incorrectly. These possible defects are inherent in the system, but do not occur where finger prints are taken. The subject himself impresses his own prints, and it is immaterial whether he presses forcibly or softly, pro

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sequence, but this error would be at once detected by the classifying office, and as a matter of fact has often been discovered and remedied. There are consequently under the new system fewer possibilities of leakage, and there must necessarily be an increase in the number of successful cases. The views here expressed are fully borne out by results up to date, which appear to indicate that many identifiable cases may, in preceding years, have escaped recognition by anthropometry.

Primary Classification.—The "rolled" impressions of the digits are recorded in their natural order of thumb, index, middle, ring, and little finger—those of the right hand being in line above, immediately below them the impressions of the corresponding digits of the left hand. At the bottom of the slip the "plain" impressions of the index, middle, ring and little fingers of both hands are also taken. It is essential to correct classification that the digits should be printed in their proper sequence; and as it could happen, through inadvertence on the part of the operator, that the impression, say, of the right index might appear as that of the middle or ring finger, the following check is provided. After the "rolled" impressions have been taken, the index, middle, ring and little fingers of each hand are dabbed down on to the paper so that the imprints of their first phalanges are simultaneously made and they must of necessity appear in their proper sequence. When slips are being classified, their "plain" prints are invariably compared with the

"rolled" impressions. This check, simple as it may appear, proves completely effective. See Plates 1 and 2.

The impressions are then read off in the following pairs: right thumb and right index: right middle and right ring; right little finger and left thumb; left index and left middle; left ring and left little finger.

In rounded numbers about 5 per cent. of impressions are Arches, 60 per cent. Loops, and 35 per cent. Whorls and Composites, the proportion varying in the several digits, but the relative preponderance of Loops and Whorls being maintained. This fact has been taken into account in devising a system of primary classification.

The proportion of Arches and composites being relatively small, Arches in primary classification are included under loops, and Composites under Whorls. In primary classification therefore an impression must be either a Loop (Arches being included) or a whorl (Composites included). Taking the first pair the arrangements possible among them are: right thumb a Loop and right index a Loop; right thumb a Loop and right index a whorl; right thumb a Whorl and right index a loop; right thumb a whorl, right index also being a whorl.

The above exhausts all possible arrangements, and may be thus set out—the enumerator letters referring to the thumb or first of the pair, the denominators to the index or second of the pair:

$$\frac{L}{L};\ \frac{L}{W};\ \frac{W}{L};\ \frac{W}{W}$$

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The above exhausts all possible arrangements, and may be thus set out—the enumerator letters referring to the thumb or first of the pair, the denominators to the index or second of the pair,

$$\frac{L}{L}, \frac{L}{W}, \frac{W}{L}, \frac{W}{W}$$

We have the same number of combinations for the second pair, and, as each of these can be combined with each arrangement of the thumb and index, the total combinations of the two pairs taken together is 16. The third pair has similarly four arrangements, which, taken with those of the preceding two pairs, raises the number of combinations to 64; adding the fourth pair this number rises to 256, and with the fifth pair to 1024. The number 1024 is the square of 32, so a cabinet containing 32 sets of 32 pigeon-holes arranged horizontally would provide locations for all combinations of Loops and Whorls of the ten digits taken in pairs. The manner in which they would be arranged in pigeon-holes is shown in Plate 3. In practice it is found more convenient to take impressions, not on cards, but on stout paper foolscap size, termed "slips," and to keep them arranged in open files, each file or, when the accumulations are small, each subdivision of a file corresponding to a pigeon-hole. This enables the whole record to be more easily handled, as the slips can be turned over rapidly, and there is besides considerable saving of bulk, the slips being of less substance than cards. A record consisting of 20,000 sets of slips would pack away into half a dozen small trunks, and within the space of a few minutes could be unpacked and arranged for search.

Plate 3 explains the theory of arrangement, and an illustration is given. The frontispiece shows the filing cabinets.

Arithmetical rule for determining primary classification, etc.—Simple as is the method of determining the primary classification number with the aid of the key to the cabinet, it can be even more readily arrived at in the following way, which enables the searcher to dispense altogether with the Key.

The digits, as before, are taken in pairs, the first of the pair being shown as numerator and the second as denominator, the formula thus obtained being of the following kind:

$$\frac{L}{W}, \frac{W}{L}, \frac{L}{L}, \frac{W}{W}, \frac{L}{W}$$

When a Whorl occurs in the first pair it counts 16, in the second pair it counts 8, in the third 4, in the fourth 2, and in the fifth 1; no numerical value is given to a Loop. The above formula can then be expressed as

$$\frac{0}{16}, \frac{8}{0}, \frac{0}{0}, \frac{2}{2}, \frac{0}{1}$$

Numerators are added together, also denominators, and the totals exhibited as a new fraction $\frac{10}{19}$. To both numerator and denominator 1 is added, making $\frac{11}{20}$, and this fraction inverted gives the primary classification number $\frac{20}{11}$, which represents that the impression slip will be found in the twentieth pigeon hole of the eleventh horizontal row.

If instead of the key given in Plate [illegible] the following Key be adopted,

I L	W L
I W	W W

the above rule becomes simplified to the extent that no inversion of the fraction obtained by adding together the numerical values given to Whorls in numerators and denominators is required. It may be stated here that the numerical rule was not discovered until after the Key shown in Plate 3 had been brought into use, otherwise the alternative Key might have been adopted with a view to simplifying the numerical rule.

Given the primary classification number, it obviously is easy to work backwards and determine the type of each digit. Taking the primary classification number $\frac{20}{11}$, it is seen that 20 falls short of 32 by 12, which is equivalent to 8 + 4; we know therefore that Whorls are wanting in the second and third pairs and in the denominator, for, as above explained, $\frac{20}{11}$ is the inversion of $\frac{11}{20}$. Similarly 11 falls short of 32 by 21, which is equivalent to 16 + 4 + 1, and we know therefore that Whorls are wanting in the first, third, and fifth pairs (numerator). Where Whorls are wanting, Loops must take their place, and so we get back at once to the formula

$$\frac{L}{W};\ \frac{W}{L};\ \frac{L}{L};\ \frac{W}{W};\ \frac{L}{W}$$

Classification numbers run not from 1 to 1024 consecutively, but from 1 to 32 of each horizontal row. Thus $\frac{4}{1}$ represents the fourth pigeon-hole or division of the first horizontal row; $\frac{10}{5}$ the tenth division or pigeon-hole of the fifth horizontal row; $\frac{31}{32}$ the thirty-first or last but one pigeon-hole of the last horizontal row.

Slips kept in files—The practice in England and India is to protect the slips by keeping them collected according to their classes, arranged between cardboards, each such collection being a file The frontispiece is a photograph of the cabinets in actual use with the slips arranged in collections It will be noticed that the size of the horizontal partitions can be increased or diminished at pleasure, that the actual number of partitions does not correspond with the divisions shown on Plate 3, which has been introduced to explain the principle which underlies the method of arrangement When the accumulations in several collections having the same denominator are relatively small, they may be kept in one file, arranged amongst themselves according to their numerator numbers In a moderate sized record, the accumulations of several collections would, in practice be kept in one file. Thus there might be only one file for all the collections under $\frac{1}{11}$ each of the slips contained in it having its correct classification number and sub classification lettering legibly noted on it in pencil, so that should a slip get out of place it can be put back

When, however, the accumulation under a particular classification number, as $\frac{1}{1}$ is very large, it becomes necessary to have separate files for each of the subclasses

On a slip being received containing impressions, all of which are Loops except the two index fingers, which are Arches, the searcher would find a dozen files marked $\frac{1}{1}$ and would select from them for purposes of search the particular file labelled $\frac{1}{1}$ $\frac{A}{A}$

It is undesirable to increase overmuch the number of files, but this is a lesser evil than keeping them too bulky for convenient handling. No file should contain slips belonging to collections having different denominators, or it may be stated thus: the denominator of the classification numbers of all slips kept in one file must be the same.

Secondary or subclassification.—Owing to the occurrence, under certain primary classification numbers, of large accumulations, secondary or subclassification is required to break them up into groups of convenient size. Similar trouble is experienced with measurements under the anthropometric system, the tendency where length of head or width of head or length of forearm is "long" or is "short" for the other measurements to be "long" or to be "short" being very noticeable. To secure a fairly even distribution of the cards amongst the 243 pigeon-holes under that system it has been found necessary to provide subsidiary limits, varied according as the forearm is "long," is "medium," or is "short." This will be understood from Plate 4, which is the Key (used whenever the anthropometric system was worked in India) to the cabinet containing all the measurements of persons whose head length is "medium." There is a similar Key for "long" length of head and for "short" length of head. The limits laid down vary, it will be seen, in all three columns, and no searcher could safely commit them to memory. This Key, in exhibiting how restricted are the range limits, explains why so

many searches became necessary when the allowance in excess and defect to discount the personal equation error is made. Such complications do not trammel the finger print system.

As has been previously stated, the fingers are impressed in their natural sequence, the thumb first, then the index, middle, ring, and little finger, those of the right hand being above and immediately below each of its digits, the corresponding digit of the left hand. The index finger of each hand is taken as a *fulcrum*, the mark specialising it being the capital letter of its symbol, the mark specialising the thumb being the small letter of its symbol placed to the left of the *fulcrum*, the marks specialising the remaining fingers being the small letters of their symbols to the right of the *fulcrum*. Arches, Tented Arches, and *radial* Loops being of relatively infrequent occurrence are utilised in subdividing, and their presence is invariably noted in the subclassification formula. This formula is in the form of numerator and denominator, the numerator referring to the right, the denominator to the left hand. Formula $\frac{1}{1}\ \frac{aAr}{rRa}$ indicates that the slip containing the impressions will be found under classification number $\frac{1}{1}$, and will there be found included in the collection specialised by having an Arch in the right thumb, an Arch in the right index, and a *radial* Loop in one of the remaining digits of the right hand, while the left thumb and index are *radial* Loops, one of the other digits of this hand being an Arch.

Subclasses formed by Arches and radial Loops.—Classification number $\frac{1}{1}$ contains the slips all the impressions of which are Loops as distinguished from Whorls (Loops including Arches, Tented Arches, *radial* and *ulnar* Loops); and we have now to consider the methods for dividing its accumulation into subclasses and groups.

Arches, *radial* and *ulnar* Loops may occur in one or both index fingers in nine combinations, as thus exhibited, and when they occur they provide for the formation of nine subclasses. The letters arranged horizontally refer to the right, those vertically to the left index.

	A	R	U
A			
R			
U			

Under subclass $\frac{A}{A}$ will be found accumulated the slips with an Arch in both index fingers; under $\frac{A}{R}$, those with an Arch in the right and *radial* Loop in the left index; under $\frac{A}{U}$, those with an Arch in the right and *ulnar* Loop in the left index. Similarly there are subclasses:

$$\frac{R}{A};\ \frac{R}{R};\ \frac{R}{U};\ \frac{U}{A};\ \frac{U}{R};\ \frac{U}{U}$$

these nine subclasses representing the nine combinations.

In subclass $\frac{A}{A}$, as Arches may occur in one, two,

three, four, or five fingers, the number of groups created by utilising them may be thus exhibited:

1	2	3	4	5
-	A	-	-	-
-	A	a	-	-
-	A	-	a	-
-	A	-	-	a
-	A	a	a	-
-	A	a	-	a
-	A	-	a	a
-	A	a	a	a

1	2	3	4	5
a	A	-	-	-
a	A	a	-	-
a	A	-	a	-
a	A	-	-	a
a	A	a	a	-
a	A	a		a
a	A	-	a	a
a	A	a	a	a

where 1 denotes the position of the thumb, 2 of the index, 3 of the middle, 4 of the ring, and 5 of the little finger. There will be a like number of groups for the fingers of the other hand, and, as both hands are utilised in splitting up subclasses, the total number that may be created by this device is $16 \times 16 = 256$. An equal number of groups will be created by the occurrence of *radial* Loops in both hands, or of *radial* Loops in one and arches in the other. In subclasses $\frac{A}{A}$; $\frac{A}{R}$; $\frac{R}{A}$; $\frac{R}{R}$, 256 such groups can be made.

This, however, is a number in excess of requirements, and in practice a smaller number are employed, formed upon deciding whether there are one, two, or three Arches to the right of the index or *fulcrum*. These groups are A; aA; Aa; aAa; A2a; aA2a; A3a; aA3a; they are arranged amongst themselves in the order here given. This substitutes 64 for the possible 256 groups. When Tented Arches take the place of Arches, they are placed below the

slips containing Arches to the same number. Thus aAt would be disposed immediately below the aAa group ; aAat below the aA2a group. When *radial* Loops occur they are disposed immediately below the groups containing the same number of Arches and Tented Arches ; aAr would be placed next below group aAt and aAar below aAat.

In subclasses $\frac{A}{U}$; $\frac{R}{U}$, the numerators provide 16 combinations and the denominators a number of combinations formed by ridge *counting*, the details of which are explained when subclass $\frac{U}{U}$ is being dealt with. In subclasses $\frac{U}{A}$; $\frac{U}{R}$, there are 16 possible combinations in the denominator and in the numerator, combinations from ridge *counting*.

In subclass $\frac{U}{U}$, although both index fingers are *ulnar* Loops, Arches or *radials* may occur in the remaining digits, and groups can be formed accordingly. This subclass splits into two, the first denoted as $\frac{U}{U}$ (lettered), of which instances are $\frac{aU}{U}$; $\frac{U}{aU}$; $\frac{Ua}{U}$, etc., the term "lettered" referring to the appearance on either side of numerator or denominator of the letters a, r, or t. The other subclass is $\frac{U}{U}$ (unlettered).

Subdivision by ridge counting.—These methods of selection for separate subclasses leave the residuum under subclass $\frac{U}{U}$ in which all the impressions are *ulnar* Loops. The proportion of slips containing such impressions lies between 4 and 5 per cent. of the total record, and necessarily in a large record represents a considerable number of slips, which are, however, reduced to convenient sized groups. The number of ridges which intervene between the

"inner" and "outer terminus" can, with the aid of a reading glass and a pointer, be *counted* correctly. A little practice gives the needed accuracy. Trials made with many thousand impressions yield the following results. In the index finger the number of impressions which have from one to nine ridges between the inner and "outer terminus" (*both these fixed points being excluded from count*) equals the number of impressions with ten or more than ten ridges. In the middle finger, the number with from one to ten ridges equals the number with eleven or more. Calling the lower limit I and the higher limit O, taking both index and middle finger of each hand, the number of arrangements possible may be thus set out, the letters horizontally disposed referring to the right index and middle, those vertically to the index and middle of the left hand. This represents 16 groups, viz.:

	11	10	01	00
11				
10				
01				
00				

$$\frac{11}{11};\ \frac{10}{11};\ \frac{01}{11};\ \frac{00}{11};\ \frac{11}{10};\ \frac{10}{10};\ \frac{01}{10};\ \frac{00}{10};\ \frac{11}{01};\ \frac{10}{01};\ \frac{01}{01};\ \frac{00}{01};$$
$$\frac{11}{00};\ \frac{10}{00};\ \frac{01}{00};\ \frac{00}{00}$$

which amongst themselves are arranged in the above order.

The advantage of this method is that in most instances it is possible to decide on view whether the ridge *counts* fall within the lower or higher limit. The eye can decide at a glance that an impression with 15 ridges falls within the O limit, one with 5

within the I limit, and this means much saving of time in subclassifying. It is only when the ridge *count* approaches the limit between I and O that greater accuracy is needed.

In each of these 16 groups the slips are arranged amongst themselves according to the *count* of ridges in the right little finger. This represents a further splitting up, the subgroups thereby created being so small as to render search comparatively easy and rapid. The full formula for one of these slips would be of the following kind:

$$\frac{1}{1}\,\frac{U}{U}\left(\frac{IO}{OI}\right)^{6}.$$

The searcher would proceed to the accumulation of slips marked $\frac{1}{1}$, select the file $\frac{U}{U}$, containing subclass $\frac{U}{U}$, and search in subgroup 6 of group $\left(\frac{IO}{OI}\right)$ of this file.

This application of the principle of *counting* the ridges in four fingers is not confined to subclass $\frac{U}{U}$, but is employed in the other subclasses of $\frac{1}{1}$, and may be employed in classes $\frac{5}{1}$, $\frac{9}{1}$, $\frac{1}{2}$, $\frac{5}{2}$, $\frac{9}{2}$, $\frac{10}{2}$, $\frac{13}{2}$, $\frac{9}{6}$, $\frac{10}{6}$, $\frac{1}{17}$, $\frac{5}{17}$, $\frac{9}{17}$, $\frac{13}{17}$, $\frac{1}{18}$, $\frac{5}{18}$, $\frac{9}{18}$, $\frac{13}{18}$, $\frac{14}{18}$, $\frac{9}{22}$, $\frac{10}{22}$, $\frac{13}{22}$, $\frac{14}{22}$ to break their subclasses into groups when their totals are sufficiently large to require such minute subdivision

Subdivision by ridge tracing.—There are marked accumulations under the classification numbers, where are collected together the slips containing impressions all or nearly all of which are Whorls (including Composites), and subclassification here is needed. Ridge *tracing* has been explained.

As specialised by the course of the lower limb of the ridge forming the left delta, a Whorl may be I or M or O. The index and middle finger of the right hand being taken, the former may be I or M or O, and the middle finger may also be I or M or O, so the combinations of the two fingers taken together will be nine, and, when these are taken with the similar arrangements for the corresponding two fingers of the left hand, the total number of combinations rises to eighty-one, each of which represents a separate determinable group. These may be shown in the following diagram, where the letters set out horizontally refer to the right hand, the first of each pair specialising the index and the second the middle finger, while the letters set out vertically refer to the left hand:

	II (1)	IM (2)	IO (3)	MI (4)	MM (5)	MO (6)	OI (7)	OM (8)	OO (9)
II (1)									
IM (2)									
IO (3)									
MI (4)									
MM (5)									
MO (6)									
OI (7)									
OM (8)									
OO (9)									

The full formula for a slip in which all or most of the impressions are Whorls would be of the following kind: $\frac{32}{32}\frac{IO}{MI}$ or $\frac{31}{32}\frac{MM}{II}$, where the figures represent the primary and the lettering the subclassification. To further simplify this, the lettering, as shown in the diagram, may be more concisely expressed [illegible]

figures, and the above formulæ would then become $\frac{32}{32}\left(\frac{3}{4}\right)$ or $\frac{31}{32}\left(\frac{5}{1}\right)$, where the figures in brackets denote the groups formed under classification numbers $\frac{32}{32}$ and $\frac{31}{32}$. Amongst themselves these groups are disposed as follows: $\left(\frac{1}{1}\right)$, $\left(\frac{2}{1}\right)$; $\left(\frac{3 \text{ to } 9}{1}\right)$, and then $\left(\frac{1}{2}\right)$, $\left(\frac{2}{}\right)$, $\left(\frac{3}{2}\right)$, $\left(\frac{4}{2}\right)$, and so on.

Ridge *tracing* in all four fingers is used for splitting up into groups the accumulations under $\frac{27}{28}$; $\frac{31}{28}$; $\frac{32}{28}$; $\frac{28}{32}$; $\frac{31}{32}$; $\frac{32}{32}$, and is applicable to some others when the number of their slips is sufficiently large to necessitate further subdividing.

In Central Pockets, Lateral Pockets, Twinned Loops, most Accidentals, and in a fair proportion of Whorls, the differentiation into I, M, O can be made at a glance. It is only when the Whorl has symmetrically disposed deltas, that is deltas which appear to be at almost the same distance from the core, that careful *tracing* is needed. The labour entailed by noting Whorls as I, M, or O consequently is much less than might seem probable, and after a little practice will be found to have no special difficulties. Cases will occur where, owing to the imperfections of the print, it is not possible to decide with certainty, and in such instances double search is made. Thus, if it is doubtful whether a particular Whorl is I or M, search is made on the assumption first that it is I, and if this fails, search is made on the assumption that it is M.

Classification of damaged or missing fingers.—It is essential that the slips accepted for

permanent record shall contain the best impressions procurable. If the prints are clear and the ridges sharply defined, the task of classifying presents no difficulties. On receipt, the impressions are scrutinised, and if amongst them blurred or imperfect prints are discovered, the slip is returned and a more carefully prepared duplicate called for. As the impressions of convicts are taken within a few days after sentence is passed, this duplicate can be obtained at any time during their detention in jail. Skin disease and injuries have the effect of blurring or effacing the ridges. By allowing time to elapse, the disease may lessen or the effects of the injuries disappear, and the obliterated ridges will grow again and the prints from them regain their normal appearance and sharpness of outline. It should therefore be the rule in all Central Offices not to admit for permanent record, slips containing imperfect impressions, until it is ascertained that better are not procurable.

When a digit is deformed or missing, no imprint of it can be taken, and the space in the slip assigned to it must remain blank. When one digit is deformed or missing, classification is made according to the corresponding digit of the other hand. If the same digit of both hands is missing, the impressions are held to be Whorls (M) and classification made accordingly. The absence of even more than two digits does not prevent classification.

An interesting case which occurred in 1903 bears upon this point.

In January of that year, the dismembered bodies of a man of the name of Darby, and of his wife and

child, were found buried in sacks in a garden at Leyton. Inquiry showed that the probable culprit was one Edgar Edwards, the tenant of the house at Leyton, to which he had removed the bodies, packed in sacks, from Camberwell, where he had murdered all three members of this unfortunate family. On his arrest, his finger prints were taken so as to establish his identity, which at the time was unknown, but in the slip submitted for search. the print of the left middle finger was missing, as it was found to be seriously inflamed, or in such a state that its impression could not be secured. As it transpired later, this inflammation was due to septic poisoning, caused by his cutting the finger while using it in the process of dismembering his victims.

Leaving blank the space occupied by this left middle finger, the formula of Edgar Edwards' finger impressions was:

$$\frac{L}{L};\ \frac{L}{L};\ \frac{L}{L};\ \frac{L}{-};\ \frac{L}{L}$$

It was necessary only to assume that this left middle finger was (*a*) a Loop, (*b*) a Whorl, and search accordingly, to make the search exhaustive. This assumption provided for the following classification:

$$(a)\ \frac{L}{L};\ \frac{L}{L};\ \frac{L}{L};\ \frac{L}{L};\ \frac{L}{L}=\frac{1}{1}$$

$$(b)\ \frac{L}{L};\ \frac{L}{L};\ \frac{L}{L};\ \frac{L}{W};\ \frac{L}{L}=\frac{3}{1}$$

Both Index fingers being radial Loops, the possible formulæ under (*a*) were:

$$\frac{1}{1}\ \frac{R}{R}\ \frac{II}{II}6;\quad \frac{1}{1}\ \frac{R}{R}\ \frac{II}{IO}6;\quad \frac{1}{1}\ \frac{R}{Ra}6;\quad \frac{1}{1}\ \frac{R}{Rr}6;\quad \frac{1}{1}\ \frac{R}{Rt}6$$

and under (*b*)

$$\frac{1}{1}\ \frac{R}{R}\ \frac{U}{I}$$

Edwards' left middle finger proved to be an *ulnar* Loop with 15 *Counts* It was found on the second search under $\frac{1}{1}\ \frac{R}{R}\ \frac{U}{10}$ His identity was at once established as that of a man who had undergone penal servitude, and who, while in prison, had made a desperate attempt to escape He was placed on trial charged with murdering Mr and Mrs Darby and their child, and was convicted and duly executed

Subclassification continued.—The methods adopted for breaking up the largest accumulations viz those in which all or nearly all the impressions are Loops or are Whorls, having been understood, little difficulty will be experienced with the smaller accumulations They are dealt with on similar lines, the presence of Arches or Radials being utilised, and ridge *counting* or ridge *tracing*, or both, being employed

The Primary Classification number having been worked out and recorded, the slip is again inspected An Arch or Radial in any of the digits at once arrests attention, and its presence shapes subclassification

In Plate 2, if there were an Arch in the right thumb, the formula would be changed to $\frac{13}{\ }\ \frac{aU}{U}$, if in the right middle to $\frac{13}{18}\ \frac{Ua}{U}$, if in the left middle, to $\frac{13}{18}\ \frac{U}{Ua}$ With a *radial* Loop in the right thumb it would be $\frac{13}{-}\ \frac{rU}{U}$; in the right middle or little finger, $\frac{13}{18}\ \frac{Ur}{U}$, in the left middle or little finger $\frac{13}{18}\ \frac{U}{Ur}$,—all

these representing groups so small as to need no further subdividing.

With an Arch in both indexes, it would be $\frac{13}{18}\,\frac{A}{A}$; an Arch in one index, $\frac{13}{18}\,\frac{A}{U}$ or $\frac{13}{18}\,\frac{U}{A}$ or $\frac{13}{18}\,\frac{A}{R}$; and with Arches or Radials in the other digits also a large number of groups, as has already been explained at length, could be formed.

Having disposed of the slips in which Arches and Radials occur, we now deal with the remainder; and it must be understood that the subdivision here described is required only when, owing to the record being very extensive, accumulations become relatively large. If the index and middle of the right hand are Loops, their ridges are *counted*, and the combined result exhibited as numerator of the sub-classification fraction (in brackets); if index and middle of left hand are Whorls, their ridges are *traced*, and their combined result exhibited as denominator.

In $\frac{13}{1}\,\frac{U}{U}\left(\frac{IO}{II}\right)$; $\frac{5}{2}\,\frac{R}{U}\left(\frac{II}{OO}\right)$; $\frac{9}{6}\,\frac{U}{U}\left(\frac{OI}{OO}\right)$; $\frac{13}{22}\,\frac{R}{R}\left(\frac{IO}{II}\right)$ the index and middle of both hands being Loops, the numerator and denominator exhibit the combined result of ridge *counting* in the index and middle of right and left hand respectively.

It will be noticed that, when a *radial* occurs in the index alone, the further subdivision is carried out precisely as if it were an *ulnar* Loop, but the group so formed will be found not under subclass $\frac{U}{U}$, but under subclass $\frac{U}{R}$; $\frac{R}{R}$; $\frac{R}{U}$.

In $\frac{11}{4}\left(\frac{IO}{MM}\right)$; $\frac{15}{20}\left(\frac{II}{MO}\right)$; $\frac{16}{20}\left(\frac{OI}{OM}\right)$; $\frac{16}{24}\left(\frac{OI}{IM}\right)$ the

numerator represents the combined result of ridge *counting*, the denominator of ridge *tracing*.

In $\frac{27}{12}\left(\frac{MO}{OM}\right)$; $\frac{31}{12}\left(\frac{IM}{MM}\right)$; $\frac{27}{16}\left(\frac{IO}{MI}\right)$; $\frac{28}{16}\left(\frac{MI}{OO}\right)$ both numerator and denominator exhibit the combined result of ridge *tracing*.

In $\frac{17}{9}\left(\frac{MO}{II}\right)$; $\frac{25}{30}\left(\frac{MM}{II}\right)$; $\frac{29}{30}\left(\frac{OM}{OI}\right)$; $\frac{30}{30}\left(\frac{OO}{II}\right)$ the subclassification numerator represents the combined result of ridge *tracing*, the denominator the combined result of ridge *counting*.

When the index and middle of the same hand are of different types, *i.e.* one a Loop and the other a Whorl, the index only is dealt with, its ridge *counting* or ridge *tracing* result alone being exhibited. This applies to both hands.

In $\frac{9}{9}\left(\frac{I}{II}\right)$; $\frac{9}{10}\left(\frac{O}{IO}\right)$; $\frac{9}{26}\left(\frac{I}{OI}\right)$; $\frac{13}{26}\left(\frac{O}{OI}\right)$ the right index is a Loop, right middle a Whorl, both left index and middle being Loops: the numerator shows the result of ridge *counting* in the right index only, the denominator the combined result of ridge *counting* in left index and middle.

In $\frac{28}{2}\left(\frac{M}{I}\right)$; $\frac{31}{18}\left(\frac{M}{O}\right)$; $\frac{31}{22}\left(\frac{I}{O}\right)$; $\frac{32}{22}\left(\frac{O}{I}\right)$ the right index is a Whorl, the right middle a Loop, the left index a Loop, the left middle a Whorl: the numerator gives the result of ridge *tracing* in the right index only, the denominator the result of ridge *counting* in the left index only.

The largest accumulations are found under Primary Classification numbers $\frac{1}{1}$; $\frac{5}{1}$; $\frac{9}{1}$; $\frac{1}{2}$; $\frac{9}{2}$; $\frac{1}{17}$; $\frac{5}{17}$; $\frac{13}{17}$; $\frac{9}{18}$; $\frac{13}{18}$; $\frac{28}{32}$; $\frac{31}{32}$; $\frac{32}{32}$. The first ten are reduced to groups by utilising the presence of Arches or Radials or by ridge *counting*, the index and middle of

both hands in these ten accumulations being Loops. The last three are reduced by ridge *tracing*, the index and middle of both hands being Whorls.

The complete scheme of classification and sub-classification, as explained in preceding pages, is exhibited in Plate 5.

As an additional check against any clerical error which might occur in writing the name of the person whose finger prints are taken on the form I. or II. through inadvertence, when several persons are having their finger impressions taken, the precaution of having the print of the right index finger made on the back of the form immediately after the signature is written is prescribed. By this means a mistake can at once be detected by comparing the impression with the print on the other side, which is folded over for the purpose. The signature and the finger impression should invariably be taken on the back of each form at once.

Application of system to police working.—The manner in which the systems works in the Police Department may be described.

A man charged with housebreaking and theft is convicted under the name of John Smith, sentenced to a term of imprisonment, and sent to jail, where his finger prints, together with the finger prints of other prisoners received, are taken by a prison warder. On the back of each slip is recorded the prisoner's name, with dates and full particulars of the case, and the slip thus filled up is forwarded to the Central Office. On receipt there, they are classified

by one officer, and his work is tested by another, before they are filed in their respective collections and groups If, through inattention or haste, the classifier makes a mistake, it will be detected by the testing officer, and as, moreover, the whole Record, by instalments, is systematically examined from time to time with a view to detecting incorrect classification, the likelihood of errors escaping notice is extremely small No Key, it will have been noticed is used or is required The data for classifying are so few and so simple that any person can carry them in his memory—method and accuracy only being needed The staff at the Central Office, being picked out as men possessing aptitude for the work, by practice soon become experts in it

After the lapse of a year or two, the Central Office receive from police or Governor of a jail a slip, containing the finger prints of a man on trial for theft, who has given the name of William Jones, and other information concerning himself, which the inquiries locally made show to be false

Method of search —On receipt of the slip one officer draws up the search form containing the full formula, viz $\frac{13\ U}{18\ U}\left(\frac{10}{10}\right) 11$, and makes over the slip and the search form to the searcher, who first verifies the correctness of the formula, and then proceeds to search The type in all the impressions is unmistakable, so there can be no doubt as to the correctness of the Primary Classification number $\frac{13}{18}$—the subclassification $\frac{U}{U}\left(\frac{10}{10}\right)$ of index and middle of the two hands is also obviously correct—but the

may be divergence of opinion as to there being exactly 14 *counts* in the right little finger. To eliminate the possibility of error arising from this, he decides to search through the subgroups of $\frac{13\ U}{18\ U}\left(\frac{10}{10}\right)$, which have from 12 to 16 *counts* in the right little finger. Being confident of the correctness of his own counting, he would first search the subgroup with 14 *counts* in the little finger, then the subgroups with 15 and 16, and then the subgroups with 13 and 12. If the slip he is looking for is in the Criminal Record, he knows it must be among subgroups 12 to 16 of $\frac{13\ U}{18\ U}\left(\frac{10}{10}\right)$, which file he picks out, and he concerns himself no further with ridge *counts*, but concentrates attention upon the salient features of the slip. The right thumb is a Lateral Pocket, the left thumb a Twinned Loop. He turns the slips of subgroups 12 to 16 over rapidly, much in the same way as a pile of bank notes are looked through, and delays only when he comes to a slip the right thumb impression of which is a Lateral Pocket, and his eye then glances at the left thumb. If it is not a Twinned Loop, he passes on to the next slip, and finally stops at one which has the right thumb a Lateral Pocket, the left thumb a Twinned Loop, and the two ring fingers Central Pockets. He then *compares the ridge characteristics of one or* two impressions on the slip in his hand with the corresponding impressions of the slip in the Record, and if they agree he knows that his search has been successful. The Central Office then inform the requisitioning police that the so called Wm. Jones was, on a specified date, convicted under the name of

John Smith, of housebreaking with theft, and give all the information concerning him recorded on the back of their slip, which is sufficient to enable the local police to prove, in the manner prescribed by law, the previous criminality of the *soi disant* Wm Jones

Although $\frac{13}{18}$ is amongst the largest of the accumulations, exhaustive search for a duplicate in it, even when the Record consists of 100,000 slips, can be completed within a limit of five or six minutes A practised person carries photographed on his eye the salient features of the slip he is looking for, and can search for it as rapidly as his hand is able to turn over the Record slips

Gradational cases —It will be noticed that the possibility of search extending beyond subgroup 11 of $\frac{13}{18}$ $\left(\frac{10}{10}\right)$ has been discussed, and this leads to the consideration of what may be termed gradational or transitional cases

Doubt may arise as to the type of an impression, and consequently as to its correct Primary Classification number In Plate 1 it might be contended that the right index is not a characteristic Central Pocket the details of its pattern placing it on the border line which separates Loops from Central Pockets, and that some persons might classify it as an *ulnar* Loop, others as a Whorl (Central Pocket) If the right index is a Central Pocket, the Primary Classification number is —, if it is a Loop it would be 1 To eliminate any uncertainty arising from the possibility of varying classification, search is made in

the accumulations under both numbers, and in the groups here specialised, viz., Plate 1, $\frac{26}{2}\frac{O}{OO}10$. and $\frac{10}{2}\frac{Ur}{aR}10$.

The groups indicated contain few slips in both $\frac{26}{2}$ and $\frac{10}{2}$, and so this double search, even when the Record is very extensive, occupies little time.

Doubt may arise whether there are exactly 9 ridge *counts* in an index finger utilised in sub-classifying. If there are 9 or less it is I; if more than 9 it would be O. Search is made first on the assumption that it is I, and then on the assumption that it is O; and this must prove exhaustive. The proportion of cases in which double search is required is small, and, though the prolongation of the process takes up extra time, the arrangement of the files is such that the searcher can pass from file to file or from group to group rapidly, and is really able to compare the slips as fast as he can turn them over.

Gradational cases, whether known as hybrids, sub-species, varieties, or under other names, are common to all sciences. A definition can only make known a finite number of the characteristics of an object selected as the type, and it is always possible that objects agreeing in the assigned characteristics may differ in others, and by gradation, insensibly varying from each other, depart more and more from the defined type.

When it is realised that even at the present time no rigorous boundary can be laid down between the vegetable and animal kingdoms, it will not appear

anomalous that gradational forms should occur in any system of finger-print classification however carefully worked out. That their occasional presence in no degree hampers the application of the system to practical working, will be manifest to those who have the opportunity of conducting searches under it.

FINGER PRINTS FOUND AT THE SCENES OF CRIME

How to Photograph and Prepare Exhibits for Production in Court

Chief Inspector Charles Collins, of the New Scotland Yard Finger Print Department, has prepared the following note which explains the method adopted in London —

Evidence as to the identification of persons by means of finger prints, when given by competent witnesses is accepted in Criminal Courts

Crime investigators should know the method by which finger prints are compared for the purpose of deciding questions of identity so that, with the aid of a reading glass, they can readily determine whether or not any particular impression possesses sufficient clearly *defined characteristic detail for the purpose of* fixing identity

Any article with a smooth surface is likely to *retain* imprints of value if touched Finger prints on rough surfaces are, as a rule, of little use

Latent impressions can be developed with the aid of powders If the marks are on blades of knives, plated goods, or on surfaces of a dark nature, "Grey" powder (mercury and chalk is sold commercially by chemists) is used If the impressions are on paper or on surfaces of a light colour, graphite or lamp black will develop them The powders ought to be

used sparingly with a fine camel hair brush. All superfluous powder must be blown or brushed away.

Unless the prints are latent, powder should not be used at the time of discovery by the Investigating Officer, as it sometimes happens that the powder reduces the area available for comparison by obscuring some of the characteristic detail. It is always possible for a skilful photographer to obtain a satisfactory photograph without the use of powder when the detail is discernible, though faint.

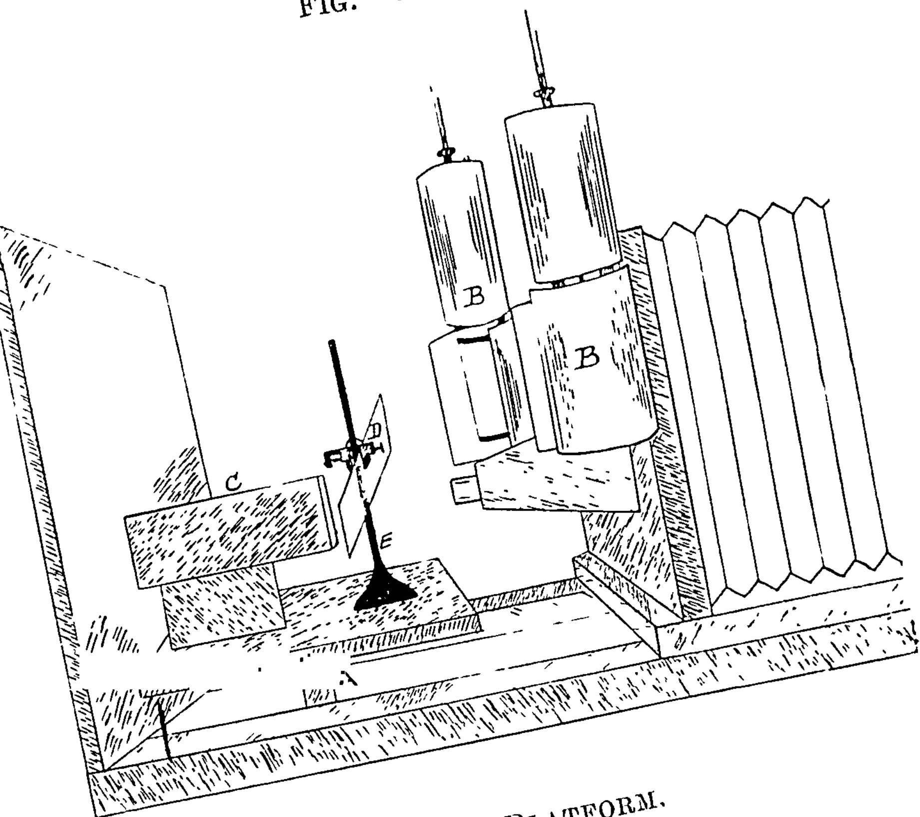
When finger prints are on a part of a broken window, the remaining pieces should be preserved so that they might, if necessary, be fitted together, thus supplying evidence as to a particular piece being part of the window broken. Similar precaution should be taken in other instances if considered necessary.

In all cases where finger prints are found at the scene of a crime, the Officer should endeavour to ascertain whether or not they are the prints of any person residing in the house, or those of a police officer or other person who may have arrived earlier on the scene.

It should be distinctly understood that finger marks which do not disclose clearly defined detail when viewed through a reading glass are generally found to be useless when photographed.

At New Scotland Yard much care and thought has been given to the photographing of finger marks, and as a result, efficient appliances have been installed. They include a large camera with sufficient bellows extension to enable prints to be enlarged six diameters, two powerful electric arc lamps which, by

Fig. "A."



A—Rising Platform.

B—Electric Arc Lamps

C—Velvet Lined Box.

D—Vice.

E—Metal Rod.

means of overhead rails, can be placed in any position; and an enlarging lantern capable of enlarging a finger print sixty diameters.

Figure "A" illustrates the way in which finger perspiration marks on a piece of glass are photographed.

The glass is placed between the jaws of a small vice. The vice has a fitting attached which permits of its *sliding* up or down *a metal rod*. The metal rod has a heavy base to keep it steady. A thumb screw is *fitted so that* the vice can be fixed to the rod at any height. A box about 18 inches deep of cross section 6 inches square, lined with black velvet, is placed on its side with the open *end* immediately behind the finger mark. The rays of light from the lamps are *not* permitted to reach the far *end of the interior* of the box, thus *ensuring a dead* black background. The lights (one on each side of the lens) are *arranged* in such position *that* the [illegible] when focussed on the screen of the [illegible] light on a dark ground. This [illegible] a finger *print* taken *with* ink [illegible] is dark on a light ground, [illegible] made from the first by [illegible] would make a lantern [illegible] *from the second plate.* [illegible] in the dark *slide* [illegible] that is to say the [illegible] If this is not [illegible] plate, left will [illegible] *e.g.* B [illegible] on which [illegible] away [illegible]

Finger perspiration marks on blades of knives or on plated goods are photographed in a similar manner, but the velvet-lined box is not needed. The lighting is sometimes difficult since the article must be placed and lighted in such a way that the impression will appear on the screen light on a dark ground. A little patience is rewarded by obtaining the desired result.

Similar imprints on glass bottles and tumblers are photographed by the preceding method, but the bottles are filled with a black or dark red fluid to get the necessary contrast. Tumblers can be filled with a similar liquid when the marks are on the outside of the glass, but, as a rule, better results are obtained by placing a piece of dead black paper in contact with the whole of the inside surface of the vessel with the exception of that part covered by the finger print. Another sheet of this paper prevents light entering the top.

The convexity of bottles, etc., is sometimes the cause of reflections appearing over a part of the area covered by the finger impression. This is removed by altering the position of the lamps.

When finger prints are found on the smooth side of corrugated glass, the numerous reflections are removed by filling the uneven surface with black printing ink.

The ridges of fingers when impressed heavily on a candle create furrows similar in pattern to those of the ridges. Before being photographed such imprints are treated in the following manner :—The impression is covered with printing ink, superfluous ink being

afterwards removed until only that in the furrows remain. This is a similar process to that adopted by printers when preparing an engraved name plate for press.

Finger marks in blood or dark impressions on a light surface are photographed as if black on a white ground.

It sometimes happens that when a finger covered with a liquid such as blood is impressed heavily, the pattern left indicates that of the furrows, not the ridges. If on comparison this is found to be the case a photograph showing the true sequence can be obtained by reversing the first plate and making a second by contact.

Slow plates and a developer likely to produce maximum contrast should be used

It is not possible to give definite information concerning the exposure of plates, so many factors have to be considered. When photographing a faint mark illuminated by two arc lamps with slow plates, F 22 stop and enlarging six diameters, twenty to thirty minutes exposure is given

It is not suggested that these hints cover the whole field of this interesting subject. Each case must be dealt with as occasion requires. It is thought, however, that they may assist those possessing a good knowledge of photography who are called upon to photograph finger marks found at the scenes of crime.

Figure "B" illustrates the way in which finger print exhibits are prepared at New Scotland Yard for production in Court. The characteristics, such as

bifurcations, abruptly terminating ridges, or any other noticeable peculiarities, are marked with red ink and numbered as shown.

The exhibits are enlarged six diameters. A sufficient number, usually about twelve, are prepared for distribution amongst the judge, the jury, and counsel. A few unmarked copies are always available in case they might be required.

FIG "B"



PHOTOGRAPH OF MARK ON WINDOW



PHOTOGRAPH OF AN IMPRINT OF LEFT FOREFINGER OF J H WHELLDON



SKETCH SHOWING THE CHARACTERISTICS COMPARABLE.

APPENDIX.

REPORT OF COMMITTEE TO EXAMINE INTO THE SYSTEM OF IDENTIFICATION BY FINGER IMPRESSIONS

UNDER instructions from the Government of India, the undersigned met in the office of Mr. Henry, Inspector-General of Police, Lower Provinces, on the 29th March 1897, to report on his system of identification by finger impressions

2 Mr. Henry first explained the present, or anthropometrical, system of Identification by measurements and its classification, which has yielded excellent and progressively improving results each year During 1896, four out of every possible ten cases were identified. But the system has weak points—

(a) Skilled persons are required to take the measurements and they must have sufficient education to enable them to read the instruments and to use the decimal notation This is more particularly a serious objection in India, where warders and policemen are frequently far from well-educated men

(b) Carefully made and delicate instruments are necessary to take the measurements with sufficient accuracy.

(c) The number of measurements to be taken is considerable, viz. 3 for the length of head, 3 for the width of head, 3 for length of left forearm, 3 for length of left foot, 3 for length of left little finger, and 3 for height—or 18 in all, the mean of each group of 3 is taken as the final measurement In addition to these, marks and scars are searched for and so the actual anthropometric record of one person occupies the measurer between half an hour and one hour.

taken readily and with sufficient accuracy by prison warders or police officers of ordinary intelligence.

(2) The classification of the description must be such that, on the arrest of an old offender who gives a false name, his record may be found readily and with certainty.

(3) When the case has been found among the classified descriptions, it is desirable that convincing evidence of identity should be afforded.

In the same report it is acknowledged that Mr. Galton's finger-print method completely met the first and third conditions, but they disapproved of his method of classification. Mr. Henry's classification and subclassification has, we consider, effectually got over the objections raised by them, for, out of eight thousand cards, no subclass contained more than from ten to twenty originals, and the system is capable of almost endless amplification, if necessary.

7. In conclusion, therefore, we are of opinion that the method of identification of habitual criminals by means of finger-prints as worked on the system of recording impressions, and of classification devised by Mr. Henry, may be safely adopted as being superior to the anthropometric method, (1) in simplicity of working, (2) in the cost of apparatus, (3) in the fact that all the skilled work required is transferred to the central or classification bureau, (4) in the rapidity with which the process can be worked, and (5) in the certainty of the results.

C. Strahan, R.E., *Major-General,*
Surveyor-General of India.

Alex. Pedler, F.R.S.,
Principal, Presidency College,
Calcutta.

The 31*st March*, 1897.

PLATE I.

a | \ | / | W | W

LEFT HAND.

Plain impressions of the four fingers *taken simultaneously*



RIGHT HAND.

Plain impressions of the four fingers *taken simultaneously*



Impressions taken by ______ *Date taken* ______ *Prison* ______

Governor's Signature ______ *Rank* ______

Classified at H.C. Registry by ______ *Date* ______

Tested at H.C. Registry by ______ *Date* ______

Date ______

27491

Prisoner's Signature ______________________

Right forefinger print.
To be impressed
immediately after
signature is written.



PLATE II.

This Form is not to be pinned.

H.C.R. No.

Name

Aliases

Prison

Prison Reg. No.

Classification No. $\frac{13 \cdot U \cdot 10}{18 \cdot U \cdot 10}$

RIGHT HAND.

1—Right Thumb	2—R. Fore Finger	3—R. Middle Finger	4.—R. Ring Finger.	5—R. Litt
				

Prisoner's Signature ______________________

Right forefinger print.
To be impressed
immediately after
signature is written.



PLATE 8



will be found Referring to the Key *LW* is in top right hand square, therefore we proceed to square defined by the broad continuous lines and by the horizontal numbers 17 to 32 and vertical 1 to 16 Taking the next pair *WL* we see from the Key that it is in bottom left square of $\frac{17-32}{1-16}$ *i e*, in the square defined by continuous and broken broad lines and by horizontal figures 17—24 and vertical 9—16 The next pair *LL* is in left top corner of this $\frac{17-24}{9-16}$ square *i e*, in the square defined by one broad continuous one broad broken, and two medium continuous lines, and by horizontal figures 17—20 and vertical 9—12 The next pair *WW* is in right hand bottom corner of this $\frac{17-20}{9-12}$ square, *i e*, in square marked by two broken and two continuous lines and by horizontal figures 19—20 and vertical 11—12 Finally, the last pair *LW* is in top right hand corner of this $\frac{19-20}{11-12}$ square, *i e*, is in pigeon hole $\frac{20}{11}$ Any other combination of impressions can be similarly located

SYNOPSIS OF CLASSIFIED COLLECTION.

File	Subfile	Group	File	Subfile	Group	File	Subfile	Group
1/1	A/A		1/1	A/A		1/1	A/A	
„	,	A/A	,	„	A3a/aA	„	,	A2a/aAa
„	„	aA/A	„	,	aA3a/aA		,	aA2a/aAa
,	„	Aa/A	,	,	A/Aa	,	,	A3a/aAa
„	„	aAa/A	,	„	aA/Aa	„	,	aA3a/aAa
„	,	A2a/A	,	„	Aa/Aa	,	,	A/A2a
„	,	aA2a/A	„	,	aAa/Aa	,		aA/A2a
,	„	A3a/A	„	„	A2a/Aa	„		Aa/A2a
„	„	aA3a/A	„	„	aA2a/Aa		„	aAa/A2a
„	,	A/aA	„	„	A[illegible]a/Aa	„	„	A[illegible]a/A[illegible]a
„	„	aA/aA	„	,	aA3a/Aa	„	„	aA[illegible]a/A[illegible]a
„	„	Aa/aA	„	„	A/aAa	„	„	A[illegible]a/A[illegible]a
„	„	aAa/aA	„	„	aA/aAa	„	„	aA[illegible]a/A[illegible]a
„	„	A2a/aA	„	„	Aa/aAa	„	„	A/aA[illegible]a
„	„	aA2a/aA	„	„	aAa/aAa	„	„	aA/aA[illegible]a

SYNOPSIS OF CLASSIFIED COLLECTION.

File.	Subfile.	Group.	File.	Subfile.	Group.	File.	Subfile.	Group.
1/1	A/A		1/1	A/A		1/1	A/A	
"	"	A / A	"	"	A3a / aA	"	"	A2a / aAa
"	"	aA / A	"	"	aA3a / aA	"	"	aA2a / aAa
"	"	Aa / A	"	"	A / Aa	"	"	A3a / aAa
"	"	aAa / A	"	"	aA / Aa	"	"	aA3a / aAa
"	"	A2a / A	"	"	Aa / Aa	"	"	A / A2a
"	"	aA2a / A	"	"	aAa / Aa	"	"	aA / A2a
"	"	A3a / A	"	"	A2a / Aa	"	"	Aa / A2a
"	"	aA3a / A	"	"	aA2a / Aa	"	"	aAa / A2a
"	"	A / aA	"	"	A3a / Aa	"	"	A2a / A2a
"	"	aA / aA	"	"	aA3a / Aa	"	"	aA2a / A2a
"	"	Aa / aA	"	"	A / aAa	"	"	A3a / A2a
"	"	aAa / aA	"	"	aA / aAa	"	"	aA3a / A2a
"	"	A2a / aA	"	"	Aa / aAa	"	"	A / aA
"	"	aA2a / aA	"	"	aAa / aAa	"	"	

PLATE 5—SYNOPSIS

File.	Subfile.	Group.
$\frac{1}{1}$	$\frac{A}{A}$	
,,	,,	$\frac{Aa}{aA2a}$
,,	,,	$\frac{aAa}{aA2a}$
,,	,,	$\frac{A2a}{aA2a}$
,,	,,	$\frac{aA2a}{aA2a}$
,,	,,	$\frac{A3a}{aA2a}$
,,	,,	$\frac{aA3a}{aA2a}$
,,	,,	$\frac{A}{A3a}$
,,	,,	$\frac{aA}{A3a}$
,,	,,	$\frac{Aa}{A3a}$
,,	,,	$\frac{aAa}{A3a}$
,,	,,	$\frac{A2a}{A3a}$
,,	,,	$\frac{aA2a}{A3a}$
,,	,,	$\frac{A3a}{A3a}$
,,	,,	$\frac{aA3a}{A3a}$
,,	,,	$\frac{A}{aA3a}$
,,	,,	$\frac{aA}{aA3a}$
,,	,,	$\frac{Aa}{aA3a}$
,,	,,	$\frac{aAa}{aA3a}$
,,	,,	$\frac{A2a}{aA3a}$

File.	Subfile.	Group.
$\frac{1}{1}$	$\frac{A}{A}$	
,,	,,	$\frac{aA2a}{aA3a}$
,,	,,	$\frac{A3a}{aA3a}$
,,	,,	$\frac{aA3a}{aA3a}$
$\frac{1}{1}$	$\frac{R}{A}$	$\frac{R}{A}$
		$\frac{aR}{A}$
		$\frac{Ra}{A}$
		And so on, representing 64 groups, corresponding to those of $\frac{1}{1}\frac{A}{A}$
$\frac{1}{1}$	$\frac{U}{A}$	Each having 64 groups, corresponding to those of $\frac{1}{1}\frac{A}{A}$
$\frac{1}{1}$	$\frac{A}{R}$	
$\frac{1}{1}$	$\frac{R}{R}$	
$\frac{1}{1}$	$\frac{U}{R}$	
$\frac{1}{1}$	$\frac{A}{U}$	
$\frac{1}{1}$	$\frac{R}{U}$	

File.	Subfile.	Group.
$\frac{1}{1}$	$\frac{U}{U}$	Subfile $\frac{1}{1}\frac{U}{U}$ forms two Subfiles, viz.: $\frac{1}{1}\frac{U}{U}$ (lettered), in which, though both index fingers are ulnar Loops, some of the other digits are Arches or Radials, and Subfile $\frac{1}{1}\frac{U}{U}$, in which all the digits are ulnar Loops. For details see next page.

File	Subfile	Group
1/1	U/U	(Lettered)
"	"	aU/U
"	"	Ua/U
		With groups similar to those of $\frac{1}{1}\frac{A}{A}$
1/1	U/U	II/II
"	"	IO/II
"	"	OI/II
"	"	OO/II

File	Subfile	Group
1/1	U/U	II/IO
"	"	IO/IO
"	"	OI/IO
"	"	OO/IO
"	"	II/OI
"	"	IO/OI
"	"	OI/OI
	"	OO/OI
"		II/OO
"	"	IO/OO
"	"	OI/OO
		OO/OO

Each of these 16 groups can be formed into about 16 sub-groups, according to ridge counts of right little finger

File	Subfile	Group
32/32		II/II
"		IM/II
"		IO/II

And so on As both indexes and both middles are Whorls, the Index may be I, M, or O, also the middle may be I, M, or O. Taking this, there are 9 variations for each hand, or, for the two hands together, 81 groups

File.	Subfile.	Group.	File.	Subfile.	Group.	File.	Subfile.	Group.
13/26		I/II	11/2		II/I	32/24		I/II
"		O/II	"		IO/I	"		M/II
"		I/IO				"		O/II
		And so on. Right index being Loop, but right middle a Whorl, only 2 variations in numerator. Left index and middle being Loops, there are 4 variations in denominator, which, for two hands together, give 8 groups.			And so on. Right index and middle being Loops, there are 4 variations in numerator. Left index being Loop, but left middle a Whorl, there are 2 variations in denominator. So the two hands together give 8 groups.			And so on. Right index a Whorl; but as right middle is Loop, there are only 3 variations in numerator. As both left index and middle are Whorls, there are 9 variations in denominator, or, for two hands together, 27 groups.
			11/10		I/I	29/28		II/I
			"		O/I	"		IM/I
					And so on. Both middles being Whorls, there are only 2 variations in numerator for right index, which is Loop, and 2 in denominator *for* left index, *also* a Loop, making 4 groups both hands being taken together.			And so on. Right index and middle being Whorls, there are 9 variations in numerator; but as left middle is Loop, left index only being Whorl, there are 3 variations in denominator, or, for two hands taken together, 27 groups.

The presence of an Arch or *radial* Loop in the index finger provides for the formation of a subfile or subclass.
The presence of Arches or *radial* Loops in digits other than the index fingers rovides for the formation of additional groups.

PLATE 5—SYNOPSIS

File	Subfile.	Group.	File	Subfile.	Group.	File.	Subfile	Group.
17/3		I/I M/I And so on. Both index fingers being Whorls, both middle being Loops, there are 3 variations in numerator and 3 in denominator, providing 9 groups.	31/18		I/I M/I And so on. Right index a Whorl, but middle a Loop, so 3 variations in numerator. Left index a Loop, left middle a Whorl, so 2 variations in denominator, in all 6 groups	13/28		I/I O/I And so on. Right index being Loop, but right middle a Whorl, there are 2 variations in numerator. Left index being Whorl, but left middle a Loop, there are 3 variations in denominator, making 6 groups.
29/30		II/II IM/II And so on. Right index and middle being Whorls, there are 9 variations in numerator. Left index and middle being Loops, there are 4 variations in denominator, yielding 36 groups.	15/20		II/II IO/II And so on. Right index and middle Loops, so 4 variations in numerator. Left index and middle Whorls, so 9 variations in denominator, making 36 groups.			

The presence of an Arch or radial Loop in the index finger provides for the formation of a subfile or subclass.

The presence of Arches or radial Loops in digits other than the index fingers provides for the formation of additional groups.

File.	Subfile.	Group.	File.	Subfile.	Group.	File.	Subfile.	Group.
17/1		I/II M/II And so on. Right index being Whorl, right middle a Loop, there are 3 variations in numerator. Left index and middle being Loops, there are 4 variations in denominator, yielding 12 groups.	15/28		I/II O/II Right index is Loop, but right middle is Whorl, so 2 variations in numerator. Left index and middle are Whorls, so 9 variations in denominator, making 18 groups.			
32/30		II/I IM/I And so on. Right index a Whorl, right middle a Whorl, 9 variations in numerator. Left index a Loop, left middle being Whorl, 2 variations in denominator, in all 18 groups.	13/20		II/I IO/I And so on. Right index and middle being Loops, there are 4 variations in numerator. Left index being Whorl, but left middle a Loop, there are 3 variations in denominator, making 12 groups.			

The presence of an Arch or *radial* Loop in the index finger provides for the formation of a subfile or subclass.

The presence of Arches or *radial* Loops in digits other than the index fingers provides for the formation of additional groups.

EXPLANATION OF SYNOPSIS

The system provides for the formation of 1024 files or primary classification numbers.

The data for the subclassification of 16 files are set forth in detail. Any other file may be subclassified in the same way as one of these 16.

The combinations or groups here shown being in excess of the requirements of the largest collection, only some are brought into use.

Groups are disposed amongst themselves in files or subfiles in the sequence indicated, viz.: $\frac{A}{A}$; $\frac{aA}{A}$; $\frac{Aa}{A}$, etc., or $\frac{I}{I}$; $\frac{O}{I}$, etc., or $\frac{II}{II}$; $\frac{IO}{II}$, etc., or $\frac{II}{II}$; $\frac{IIM}{II}$; $\frac{IO}{II}$, etc.,—a sequence easily remembered.

Capital letters refer to the index finger (*fulcrum*), small letters to the left of the capital referring to the thumb, those to the right of the capital letter referring to the other digits.

When Arches, Tented Arches, and Radials occur in the subclassification formula, the slip will be found in the subfile indicated by the capital letters where its location is thus *determined*: Tented Arches come immediately after Arches, and Radials after Tented Arches. If the formula is $\frac{1}{1}\frac{aAt}{aA}$, subfile $\frac{A}{A}$ is taken up, and then the slip will be found arranged below the last slip of $\frac{1}{1}\frac{aAa}{aA}$; slip $\frac{1}{1}\frac{rAa}{aA}$ will be found below the last slip of $\frac{1}{1}\frac{tAa}{aA}$, or if there be none, then below $\frac{1}{1}\frac{aAa}{aA}$, or failing that, then below $\frac{1}{1}\frac{Aa}{aA}$.

When files contain large accumulations, they are, for convenience, broken into subfiles, only some of which are exhibited here, this arrangement depending upon the size of the files.

Subclassification reduces the accumulations of files to relatively small aggregations (groups), so as to facilitate search.

By utilising the presence of Arches, Tented Arches, and Radials, and by ridge *counting* and ridge *tracing*, files are spilt up into 4, 6, 8, 9, up to 24, 36, 81 and more groups, and can, if necessary, be further reduced to subgroups, the volume of the subdivisions thus made being so small as to render search easy and exhaustive. The letterpress explains how this is carried out.

Primary classification numbers $\frac{1,\ 2,\ 5,\ 6,\ 9,\ 10,\ 13,\ 14}{1,\ 2,\ 5,\ 6,\ 17,\ 18,\ 21,\ 22}$, representing 64 files, viz.: $\frac{1}{1}$, $\frac{2}{1}$, $\frac{5}{1}$, etc., $\frac{1}{2}$, $\frac{2}{2}$, $\frac{5}{2}$, etc., $\frac{1}{5}$, $\frac{2}{5}$, $\frac{5}{5}$, etc., etc., are subdivisible as $\frac{1}{1}$, (details of which are exhibited) when their accumulations are large enough to require subdivision.

Of these $\frac{1}{1}$, $\frac{5}{1}$, $\frac{9}{1}$, $\frac{13}{1}$, $\frac{1}{2}$, $\frac{5}{2}$, $\frac{9}{2}$, $\frac{13}{2}$, $\frac{9}{6}$, $\frac{1}{17}$, $\frac{5}{17}$, $\frac{9}{17}$, $\frac{13}{17}$, $\frac{1}{18}$, $\frac{5}{18}$, $\frac{9}{18}$, $\frac{13}{18}$, $\frac{9}{22}$, $\frac{10}{22}$ are large accumulations.

Files $\frac{1,\ 2,\ 5,\ 6,\ 9,\ 10,\ 13,\ 14}{9,\ 10,\ 13,\ 14,\ 25,\ 26,\ 29,\ 30}$ are subdivisible as $\frac{13}{26}$.

Of these none are large accumulations.

Files $\frac{3,\ 4,\ 7,\ 8,\ 11,\ 12,\ 15,\ 16}{1,\ 2,\ 5,\ 6,\ 17,\ 18,\ 21,\ 22}$ are subdivisible as $\frac{11}{2}$.

Of these $\frac{11}{2}$, $\frac{16}{22}$ are moderate-sized accumulations.

Files $\frac{3,\ 4,\ 7,\ 8,\ 11,\ 12,\ 15,\ 16}{9,\ 10,\ 13,\ 14,\ 25,\ 26,\ 29,\ 30}$ are subdivisible as $\frac{11}{10}$.

Of these none are large accumulations.

Files $\frac{19,\ 20,\ 23,\ 24,\ 27,\ 28,\ 31,\ 32}{11,\ 12,\ 15,\ 16,\ 27,\ 28,\ 31,\ 32}$ are subdivisible as $\frac{32}{32}$.

Of these $\frac{27}{12}$, $\frac{28}{16}$, $\frac{27}{28}$, $\frac{31}{28}$, $\frac{32}{28}$, $\frac{27}{32}$, $\frac{28}{32}$, $\frac{31}{32}$ are large accumulations.

Files $\frac{19,\ 20\ 23,\ 24,\ 27,\ 28,\ 31,\ 32}{3\ 4,\ 7,\ 8,\ 19,\ 20,\ 23,\ 24}$ are subdivisible as $\frac{32}{24}$.

Of these $\frac{31}{20}$, $\frac{31}{24}$, $\frac{32}{24}$ are large accumulations.

Files $\frac{17,\ 18,\ 21,\ 22,\ 25,\ 26,\ 29,\ 30}{11,\ 12,\ 15,\ 16,\ 27,\ 28,\ 31,\ 32}$ are subdivisible as $\frac{29}{28}$.

Of these $\frac{29}{27}$, $\frac{29}{28}$, $\frac{29}{32}$, $\frac{30}{32}$ are moderately large accumulations.

Files $\frac{17,\ 18\ 21,\ 22\ 25,\ 26,\ 29\ 30}{3,\ 4,\ 7\ 8,\ 19,\ 20,\ 23,\ 24}$ are subdivisible as $\frac{17}{3}$.

Of these $\frac{21}{19}$, $\frac{25}{20}$, $\frac{29}{20}$, $\frac{29}{24}$, $\frac{30}{24}$ are large accumulations.

Files $\frac{17,\ 18\ 21\ 22\ 25,\ 26\ 29\ 30}{9,\ 10,\ 13\ 14,\ 25,\ 26,\ 29,\ 30}$ are subdivisible as $\frac{29}{0}$.

There are no large accumulations.

Files $\frac{17\ 18,\ 21,\ 22,\ 25,\ 26,\ 29,\ 30}{1,\ 2,\ 5,\ 6,\ 17,\ 18,\ 21,\ 22}$ are subdivisible as $\frac{17}{1}$.

Of these $\frac{17}{1}$, $\frac{25}{1}$, $\frac{25}{2}$, $\frac{21}{17}$, $\frac{29}{17}$, $\frac{25}{18}$, $\frac{29}{18}$, $\frac{30}{22}$ are large accumulations.

Files $\frac{19,\ 20,\ 23,\ 24,\ 27,\ 28,\ 31,\ 32}{9,\ 10,\ 13,\ 14,\ 25,\ 26,\ 29,\ 30}$ are subdivisible as [illegible].

Of these none are large accumulations.

Files $\frac{19,\ 20,\ 23,\ 24,\ 27,\ 28,\ 31,\ 32}{1,\ 2,\ 5,\ 6,\ 17,\ 18,\ 21,\ 22}$ are subdivisible as [illegible].

Of these none are large accumulations.

Files $\frac{3, 4, 7, 8, 11, 12, 15, 16}{3, 4, 7, 8, 19, 20, 23, 24}$ are subdivisible as $\frac{15}{20}$.

Of these none are large accumulations.

Files $\frac{3, 4, 7, 8, 11, 12, 15, 16}{11, 12, 15, 16, 27, 28, 31, 32}$ are subdivisible as $\frac{15}{28}$.

Of these $\frac{15}{28}$ is the only accumulation of any size.

Files $\frac{1, 2, 5, 6, 9, 10, 13, 14}{3, 4, 7, 8, 19, 20, 23, 24}$ are subdivisible as $\frac{13}{20}$.

Of these $\frac{1}{3}$, $\frac{5}{19}$, $\frac{13}{19}$, $\frac{13}{20}$, $\frac{14}{24}$ are moderate-sized accumulations.

Files $\frac{1, 2, 5, 6, 9, 10, 13, 14}{11, 12, 15, 16, 27, 28, 31, 32}$ are subdivisible as $\frac{13}{28}$.

Of these none are large accumulations.

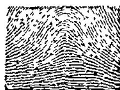
This Synopsis can be used for any collection, however large.

INDEX.

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
BY DARLING & SON, LTD., 34–40, BACON STREET, E.

1913.

Arches.


1


2


3


4


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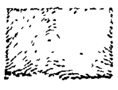

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Loops approximating Arches


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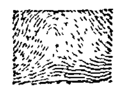

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Tented Arches


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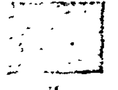

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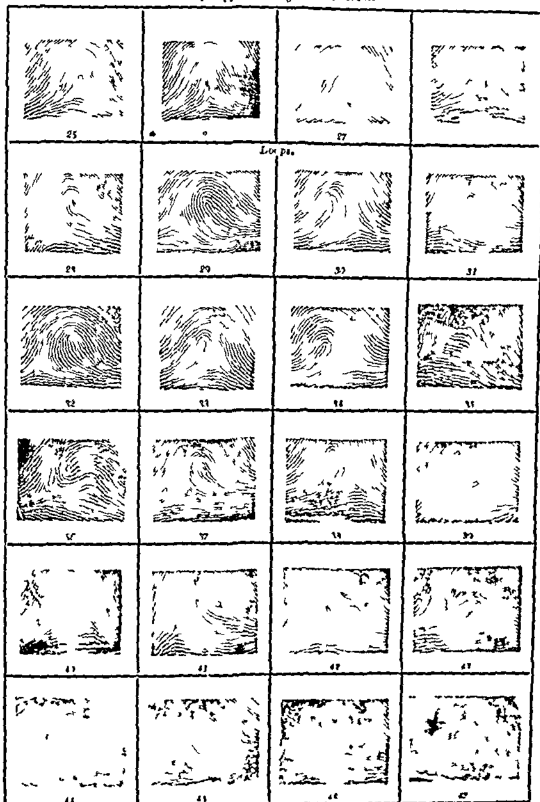

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Loops [illegible] to Tented Arches



Loops approximating Tented Arches.


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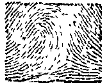

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Loops.


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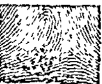

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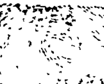

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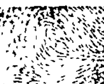

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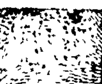

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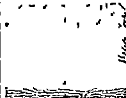

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Loops

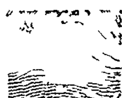


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Lateral Pocket Loops



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Loops approximating Lateral Pocket Loops



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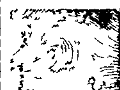
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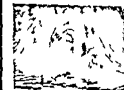
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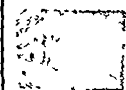


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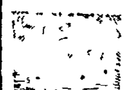
Twinned Loops



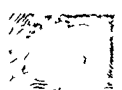
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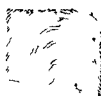
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Twinned Loops



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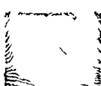
Central Pocket Loops—Standard I



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Loops approximating Standard I



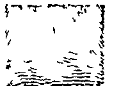
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Central Pocket Loops—Standard II



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Loops approximating Standard II



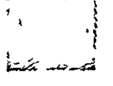
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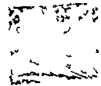


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Central Pocket Loops—Standard III







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Twinned Loops


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Central Pocket Loops—Standard I


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Loops approximating Standard I


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Central Pocket Loops—Standard II


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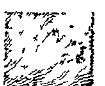

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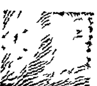


Loops approximating Standard II

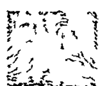

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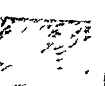

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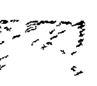

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Central Pocket Loops—Standard III


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Central Pocket Loops—Standard III



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Loops approximating Standard III



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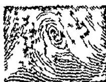


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Central Pocket Loops—Standard II



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Whorls



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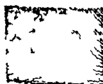
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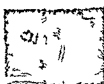
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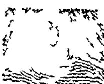
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Whorls


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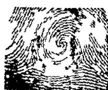

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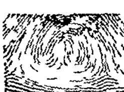

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Compound Patterns


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ILLUSTRATIONS.

Tracing the Ridges.

Inside












133 134 135 136

Meeting.










137 138 139 140









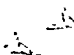

141. 142 143 144

Outside.







145 146 147 148

Counting the Ridges.

O.T.
I.T.
Counts 12

O T
I T.
Counts 13

O.T
I T
Counts 20

O T.
I.T.
Counts 13
157

O.T.
I.T.
Counts 8

O T
I T
Counts 14

O.T.
I T.
Counts 2?

O.T
I T.
Counts 5
156

O T.
I.T.
Counts 13

O T
I T
Counts 7

O T.
I.T.
Counts 11

O.T.
I T.

T.
.
unts 16
161

O T.
I.T.
Counts 7
162

O T
I.T.
Counts 8
163

O.T.
I.T.
Counts 16
164